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ABSTRACT

Designed to serve as a framework from which high school debate students, coaches, and judges can evaluate the issues, arguments and evidence present in the availability and quality of water resources in the United States, this booklet provides guidelines for research on the 1985-86 debate resolutions selected by the National Federation of State High School Associations. Following the presentation of the problem area and the three debate resolutions, the booklet's four chapters discuss (1) getting started, a review of useful information on researching the topic of water resources; (2) an overview of the general issues of water policy; (3) problems of water quality; and (4) issues of water allocation. Diagrams and tables accompany the text. (EL)

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ERIC FIRST ANALYSIS: Water Resources

ED257158

1985–86 National High School Debate Resolutions

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ERIC FIRST ANALYSIS: Water Resources

1985–86 National High School Debate Resolutions

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Foreword

Questions about water policy reflect some of the most fundamental issues facing modern governments. Debaters will be applying their insights, understandings, and attitudes about water policy throughout their adult life. An area may have great technology and mineral resources, but without water that area faces serious problems. Since the topics incorporate the leading questions about an adequate supply of potable water, a national system of priorities about allocation, and a national policy about quality, students will gain from applying the analysis in this book to the development of their actual cases. *The ERIC First Analysis* should serve as a framework from which students, coaches, and judges can evaluate the issues, arguments, and evidence present in sustaining and reforming U.S. water policy.

ERIC First Analysis, published annually since 1973, provides debaters with guidelines for research on the debate resolutions selected by state and national forensic associations in a referendum held by the National Federation of State High School Associations. It incorporates an instructional approach designed to avoid "structured" cases and "canned" evidence. Periodic surveys of teachers of debate have indicated that the *ERIC First Analysis* has proved to be an excellent resource for students to begin their study of issues and arguments.

The *ERIC First Analysis* of the 1985-86 National High School Debate Resolutions is published by the Speech Communication Association in cooperation with the Educational Resources Information Center Clearinghouse on Reading and Communication Skills (ERIC/RCS). The ERIC/RCS Clearinghouse is supported by the National Institute of Education which has as one of its missions the dissemination of knowledge to improve classroom practices. This ERIC information analysis paper is unique in that it is intended for direct use by high school students as well as by their teachers.

To be a "first" analysis, the manuscript must be prepared in a period of eight weeks after the February announcement of the national debate topic. The authors' thorough analysis of issues and sources in so short a time and their adaptation of the analysis to the needs of high school debaters are tributes to their experience and excellence as forensics educators.

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1985–86 High School Debate Problem Area and Resolutions

What is the most effective water policy for the United States?

Debate Resolutions

Resolved: That the federal government should establish a national policy to insure each United States resident an adequate supply of potable water for personal use.

Resolved: That the federal government should implement a national system of priorities to control the allocation of all water in the United States.

Resolved: That the federal government should establish a comprehensive national policy quality of water in the United States.

Preface

The purpose of this publication is to provide a brief overview of the 1985–86 high school debate resolutions. The decision-making process for selecting the problem area and resolutions is different from the system used for determining the college debate topic. Last December the National Federation offered three problem areas and nine resolutions for consideration. After six weeks of balloting by the various state and national forensic representatives, the topic area of the United States water policy won the referendum. The final resolution, however, will not be determined until December, although an early preference has been shown for the water quality topic. All of the specific resolutions are related to each other, and some case areas are interchangeable.

Whichever resolution is finally selected, the debater will have a tremendous amount of research material to assimilate. The four chapters of this book are intended to prepare debaters for their own efficient investigation of the problem area. The four chapters are: (1) getting started, a review of useful information on researching the topic of water resources; (2) an overview of the general issues of water policy; (3) problems of water quality; (4) issues of water allocation.

Since this text was written early in the debate year, it cannot encompass all possible positions that could be developed under any of the resolutions. This publication should be used to establish early research priorities on the most likely affirmative and negative arguments. Also, it provides a general overview of the kinds of issues likely to be discussed under this topic.

The opinions expressed in this work do not represent the official position of the Speech Communication Association. In most instances, the consensus view of debate theory is presented, which may not represent the personal view of the authors. As a general rule, this text emphasizes the practical rather than the exotic, the likely rather than the unlikely.

This year's publication represents a departure from past *First Analysis*. For the first time the work is coauthored. All of the planning, research, and writing for this publication was done by the authors. Editing and proofreading assistance was gratefully accepted from Christine Risley Wagner.

The task of compiling the material and finishing the manuscript under rigorous time constraints has been made easier by the patience and

understanding of both of our families and the staff, students, and faculty of the School of Arts and Sciences of California State University. The information in this publication is intended to benefit debaters and coaches, and to introduce an exciting topic of vital importance to audiences and judges alike.

David L. Wagner

Douglas Fraleigh

1. Getting Started

The Beginning

One of the most difficult tasks facing any debater is how to properly begin researching a new debate topic. Since the topic of water resources is too large to be a manageable research assignment, a plan should be devised to narrow the focus of individual library work. Similarly, a method should be employed that would increase the likelihood that more important topics will receive priority attention. Operating on the generally recognized principle that group efforts are superior to the sum total of individual efforts, this publication encourages the "brainstorming" technique often used by business or academic groups to generate ideas. Such an approach adapts easily to the needs of debate squads. Coaches and debaters should discuss possible case areas and issues likely to emerge on the water policy topics. This exchange should encourage all members of the group to volunteer information or contribute their ideas. The rules are easy to establish: (1) evaluation and criticism by group members are forbidden; (2) all contributions are to be encouraged; (3) an attempt is made to create the greatest quantity of ideas; and (4) a combination of ideas and solutions is sought.[1] A master list for the squad should be kept on concepts for cases, topicality arguments, and potential advantages or disadvantages.

This debate squad sessions does not have to be totally unstructured. The quality of the exchange would be enhanced if a few general articles on current issues of pollution, water quality, and the federal government's grants programs were read first. Another preliminary step is to review other debate topics for similarities to this year's resolution. For example, within the last six years, a high school topic dealt with consumer interest and carcinogenic substances, and within the same period, a college topic touched on similar issues. Many of the arguments raised under these resolutions continue to be relevant to analysis of the current problem area.

Research Procedures

Once a list of concepts has been accumulated, it becomes necessary to organize research assignments. A number of questions must be considered when making such assignments. Is it important to research an

affirmative case first? What areas can be covered with the sources readily available? What cases are likely to be run early in the year? Answers to questions like these will determine which ideas must be considered primary research objectives.

After a preliminary list has been developed, the most systematic method of researching is to compile brief bibliographies on each of the major issues or case areas. Although some debaters are good at chasing down obscure footnotes in books or intuitively finding useful publications, the best and most comprehensive method is to consult the library card catalog for books and indexes for periodicals or journals. The water quality issues provide a unique opportunity to utilize a wide variety of library resources. Debaters will consult material from such diverse academic areas as medicine, biology, business, economics, law, and environmental studies.

The card catalog is the main source for locating books in the library. This catalog is indexed under subject, author, and book title. There are also special reference sources essentially devoted to environmental publications. *Environmental Abstracts, Environmental Periodicals Bibliography*, and *The Environmental Index* are examples of such focused indexes. If the amount of reference material seems overwhelming, several options are available to the debater.

First, most libraries have trained reference librarians who will give assistance if requested. Second, various books explain reference sources in greater detail. Some good examples are the *New York Times Guide to Reference Materials,*[2] *Government Publications and Their Use,*[3] and *Guide to Reference Books.*[4] A third option is having a research service compile a bibliography on selected topics. A fee is charged by many university libraries or research organizations for computer retrieval of this information.

Indexes and Abstracts

Most indexes or abstracts are organized alphabetically by subject or topic and by author. While an index supplies basic information on when and where an article was published, an abstract offers the added attraction of providing a short summary of the publication. Typical subject headings on these resolutions would include environment, water, pollution, toxic wastes, pesticides, and ecology. *The Readers' Guide to Periodical Literature* is perhaps the most widely available resource index in the United States. Available in most public school libraries, this research aid surveys over 150 popular magazines covering issues of current news value. Government documents will be extremely valuable resources for this year's topic and can be found in several sources, including the *Monthly Catalog*

of U.S. Government Publications and the *GPO Sales Publications Reference File.*

Nationally distributed newspapers also provide indexes to their publications. The *New York Times, Los Angeles Times, Christian Science Monitor, Washington Post,* and *Wall Street Journal* are all respected papers with indexing systems available in many libraries. While most local newspapers will not have published indexes available, some libraries will clip and file articles on important topics. Also, *NewsBank* collects articles from local papers and places them on microfiche. Other special indexes should prove useful for a careful consideration of water policy. Among them are:

Business Periodicals Index
Indexes a wide range of magazines and journals of interest to those in business.

FDA Clinical Experience Abstracts
Provides significant human data on the usefulness, hazards, and adverse effects of drugs, nutrients, household chemicals, and pesticides. Indexes 180 domestic and foreign biomedical periodicals, principally in clinical medicine; however, some animal studies are included. Published quarterly by the Food and Drug Administration.

Health Aspects of Pesticides Abstract Bulletin
Seeks to foster current awareness of the major worldwide literature pertaining to the effects of pesticides on humans. Indexes 500 domestic and foreign journals. Published monthly by the Environmental Protection Agency.

Index to Legal Periodicals
Indexes American legal periodicals. Contains book reviews and case indexes. Printed numerous times during the year.

Index Medicus
Indexes international medical literature and references several thousand journals. Human health, biometry, botany, chemistry, entomology, physics, psychology, sociology, veterinary medicine, zoology, and environmental publications are indexed. Published monthly by the National Library of Medicine.

Pollution Abstracts
Includes journals, conferences, newsletters, newspapers, corporate reports, and new releases. Issues feature stories from both public and private organizations covering their actions in pollution prevention and control. Published bimonthly.

Public Affairs Information Service Bulletin
Reviews over 1,000 government and business publications and

government documents. Presents a brief abstract of relevant articles.

Selected References on Environmental Quality as It Relates to Health
Indexes 2,300 biomedical periodicals. Includes pollution, pesticides, drugs, ecology, and the environment. Published monthly by the National Library of Medicine.

Sources

The preferred method for systematic research on any topic is extensive use of indexes of abstracts. However, a time lag exists between the publication date for journals or periodicals and their inclusion in various indexing systems. While it is unlikely that pollution will be eliminated in a month, it is important that each debater keeps current with shifts in the actions of the Congress, the president, and the state governments. The best single recommendation is a thorough reading of a good daily newspaper. In addition, popular news weeklies such as *Newsweek*, *Time*, or *U.S. News and World Report* should be examined periodically for timely articles or major issues.

There are also a number of magazines that should be read each month. This list would include:

Bio Science
Business Week
Chemical and Engineering News
Ecology Law Quarterly
Environment
Environmental Action
Environmental Law Reporter
EPA Journal
Fortune
Journal of the American Waterworks Association
Journal of Environmental Health
National Wildlife
Science

Other publications may be more familiar to the debater and are important sources of evidence. These publications include the *Congressional Record*, which is the official account of the activities of Congress, and *Current History*, which devotes several summer issues to articles on the

high school topic. *Editorial Research Reports* and *The Congressional Digest* publish lengthier articles on other topics of current interest. An invaluable source of information on contemporary issues before the House or Senate is the *Congressional Quarterly Weekly Report.*

Investigating this topic will expose the student to a wide range of official state and federal documents related to water quality, water resources, and the environment. Figure 1 provides a graphic representation of the research process described in this chapter.

Primary Data

There is a wealth of information from primary resources on this topic. In the legal area, the debater can examine relevant court cases, statutes, and administrative regulations. Several general statistical sources provide information for a quick overview. Such publications include the *Statistical Abstract of the United States,* the *American Statistics Index,* and the *Statistical Reference Index.* In addition, various government agencies compile their own statistical reports on a regular basis. Among the more pertinent reports on this topic are those published by the Environmental Protection Agency, the U.S. Bureau of Reclamation, and the U.S. Geological Survey.

Another area of primary research involves the critique of scientific studies demonstrating a link between various types of pollution or wastes and human mortality and morbidity. The carcinogenic, or cancer-causing, effects of such substances are demonstrated as a result of animal tests or epidemiological studies of humans over a long period.[5] Much of the evidence for an initial label of "cancer-causing" comes from animal tests. Minimal group size for valid animal tests has been established. "The number is usually 50 males and 50 females, a total of 100 animals. A single test for one chemical usually consists of three-dose groups of this size and preferably two species. Such a test on the 600 animals involved over a period of two years usually is estimated to cost about $150,000 setting economic limits on the maximum numbers of animals used."[6] Dr. Lijinsky of the Frederick Cancer Research Center believes that such tests are a valid predictor of human cancers:

> First, animal tests are predictive of carcinogenicity in man, who is not an exceptional species in this regard. Secondly, there is a dose-response effect: Larger doses of carcinogen given to experimental rodents make tumors appear within two years (untreated rodents normally live only a little longer than that), whereas the comparatively small doses to which people are exposed make tumors appear in them only after a much longer time. Thirdly, not all of the exposed people developed the cancer, suggesting that a considerable variation in susceptibility to the carcinogen (which might have something to do with genetics), just as we find in experimental animals.[7]

ISSUE RESEARCH METHODOLOGY

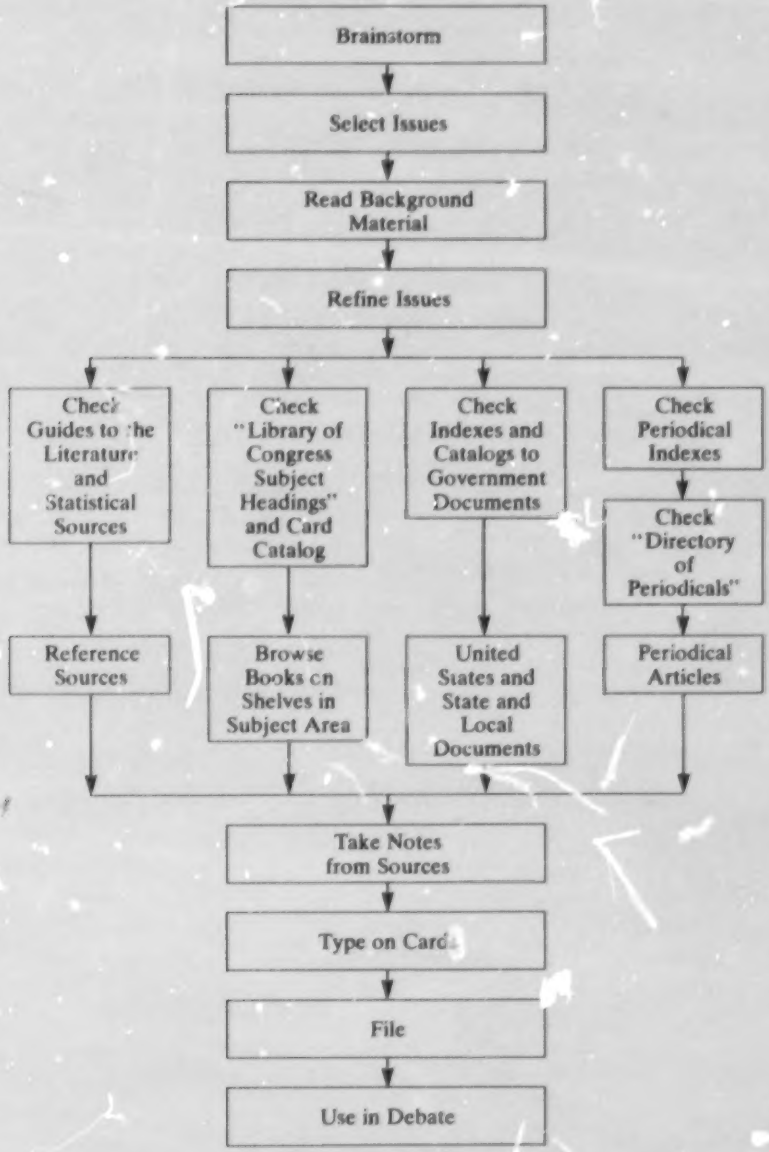

Brainstorm
Select Issues
Read Background Material
Refine Issues
Check Guides to the Literature and Statistical Sources
Check "Library of Congress Subject Headings" and Card Catalog
Check Indexes and Catalogs to Government Documents
Check Periodical Indexes
Check "Directory of Periodicals"
Reference Sources
Browse Books on Shelves in Subject Area
United States and State and Local Documents
Periodical Articles
Take Notes from Sources
Type on Cards
File
Use in Debate

Figure 1. From: Kristie and Kong, *General Business Research: Selected Sources*, California State University–Sacramento Library.

These conclusions have, at times, been substantiated in human studies. Epidemiological studies of humans have pointed to the identification of certain substances that are carcinogenic in humans, and these substances have been found equally and simultaneously to produce cancerous tumors in experimental animals. In fact, the parallel is so close that almost all substances known to be carcinogenic in humans have had the same effect in some suitable animal model.[8]

This trust in the results obtained from animal studies is not universal among researchers. As Dr. Frederick Coulston notes, "Since there are now more than 1600 chemicals that produce cancer in mice, and only about 15 are known to cause cancer in man, the odds are poor that the mouse is a good predictor of cancer to man. . . . If these chemicals were banned, an economic disaster would occur, not only in the U.S. but worldwide."[9]

Evidence Transcription

The final result of this research effort is the gathering of usable evidence to support arguments on issues raised during a debate. This evidence should meet commonly agreed upon standards for debate evidence. Among those tests of evidence mentioned by authors of argumentation textbooks are: (1) expertise of the author; (2) unbiased reporting of information; (3) timely information; and (4) verifiable sources of data.

In addition, full source citation should be available for each unit of evidence used in a debate. Coaches involved with both high school and college debate are increasingly concerned about the challenges to information used during debate rounds. Contestants are responsible for knowing and following the rules and regulations required by their leagues, state associations, and the National Forensic League on source citations and challenges to evidence.

Some debaters carry copies of important affirmative and negative sources to answer immediately requests for clarification. A caution sounded in a prior *ERIC First Analysis* deserves repeating: "Particular problems often arise when evidence is paraphrased or when seemingly irrelevant information is edited out. As a general practice, this type of editing should be avoided."[10] An example of a file card that contains full citation is provided in Figure 2.

The research process outlined here must continue throughout the year. Any topic will undergo substantial changes as the school year progresses. Professor Henderson's warning from the *1979–80 ERIC First Analysis* on a prior high school topic is still a valid observation:

> Those of you beginning to debate the new topic will want to broaden your reading, consider the implications of this first analysis, and discuss the potential implications with others. A debater should

SAMPLE CARD

(1) P4

(2) Federal Facilities

(3) J. S. Cooper; (4) Ass't Administrator for External Affairs, EPA; (5) *EPA Journal;* (6) October, 1984; (7) p. 22.

(8) Of the 544 major facilities failing to comply with the effluent limitations required by the Clean Water Act at the beginning fo fiscal year 1984, 32 (or 6 percent) were federal facilities. Of the 328 significant violators of clean air standards, 6 (or 2 percent) were federal facilities. Of the 523 major hazardous waste handling facilities with significant violations, 30 (or 6 percent) were federal facilities.

(9) DF 902

Figure 2. The numbers prefacing various parts of the sample card refer to the following: (1) code number of section for refilling, (2) brief synopsis of the content of the evidence, (3) author of quotation, (4) author's qualifications, (5) source, (6) date of publication, (7) page, (8) one central concept of evidence, (9) initials of student researcher and consecutive number of total evidence cards researched by this debater.

> never rely on a narrow base of information, whether it be a compilation of viewpoints similar to *First Analysis*, a single new source such as a news magazine, a debate quote handbook, or the coach of a debate squad. Instead, the debater must broaden her or his understanding of the political context within which the subject is being debated, and then exhibit that understanding to the reasonable, prudent, thinking individual who serves as judge for the debate.[11]

If the following chapters establish the framework for formulating a systematic consideration of this topic, their purpose has been accomplished.

2. The Problem Area: Water Resources in the United States

Overview

The issues presented in a discussion of water resources center on two interrelated concerns: water availability and water quality. These concerns combine to form the basis for the claim that the United States faces a severe water shortage that would be disastrous for the individual's and the economy's well-being. A recent forecast by the Futures Group for the Trend Analysis Program of the American Council of Life Insurance listed the water shortage as one of five potential large-scale catastrophic events facing the United States and the world. Their conclusion was:

> The United States has abundant overall water supplies but, as in the case of many other natural resources, poor management and wasteful use patterns are cutting into both supply and quality. If present trends continue, almost every section of the country will likely face some form of water shortage by the turn of the century. In the West and Southwest, the major problem is availability of supply; in the High Plains area, depletion of underground aquifers; and in the East, qualits of drinking water.[1]

Several years earlier, the *New York Times* reported that while America is generally endowed with plentiful water resources, "these supplies are being squandered through poor management and inefficient use to such a degree that water is running short in many areas."[2] As with most crises, there are numerous warning signals that should alert people to the need to rethink their strategy on the use of such resources. Duane Baumann, from the Department of Geography at Southern Illinois University, outlines several factors that have combined to thrust the issue of efficient use of water into the political arena:

> First, new reservoir sites have become increasingly scarce. Second, concern for environmental quality and for the environmental impacts of water resource development has grown. Third, groundwater resources are frequently inadequate to meet the demands of urban areas. Fourth, the political, economic, and institutional problems associated with interbasin transfers of water have proliferated. Finally, the real costs of water have risen dramatically during the last decade as a result of increases in the cost of energy, rising incremental development costs, and the higher water quality standards mandated

> by such federal legislation as the Water Pollution Control Act Amendments of 1972 and 1977 and the Safe Drinking Water Act of 1974.[3]

The general problem area for the 1985–86 high school debate topic contains three specific debate resolutions that emphasize different aspects of the water problem½ availability of potable, or drinking, water; improved water quality; and allocation of water resources. All of these resolutions are related to each other and represent three different approaches for focusing on the major policy issues generated by an examination of water resources. This chapter will describe those elements common to all three topics while Chapter 3 will explore issues related to water quality and Chapter 4 will examine issues of water scarcity. Early balloting has shown a preference for the resolution on water quality as the most likely resolution to be selected as the national topic.

Water

One term that is repeated in all three debate resolutions is "water." While it may seem self-evident, this word should be defined. A good, general definition of water is provided by *Webster's New World Dictionary:* "the liquid that descends as rain and forms rivers, lakes, and seas."[4] Water below the earth's surface also fits a reasonable definition of water. The New Mexico Supreme Court stated: "Water of underground streams, channels, artesian basins, reservoirs, and lakes . . . are included within the term 'water' as used in (the) Constitution."[5] These two concepts of water also are used in the literature on water resources and by policymakers. The Trend Analysis Program notes:

> The water that we use comes from two sources: surface water and groundwater. Surface water flows in streams and rivers and is stored in natural lakes, in wetlands, and in man-made reservoirs. Groundwater lies below the surface— in very slow moving water table aquifers or in confined artesian aquifers—and is recharged at varying rates by infiltration from precipitation and surface water. It is withdrawn by pumping but can also emerge as natural springs or enter the ocean as subsurface flow.[6]

It is important when seeking to define a term that the context of word usage is examined. Otherwise, the researcher will receive a distorted image. For example, a court case interpreting an insurance policy may conclude that the phrase "water damage" does not include damage from underground water. The reasoning behind such a ruling is not, however, that underground water cannot be defined as water. Instead, what a court will probably be concluding is that the insurer and insured only intended for the policy to include damage from above ground waters. Such a

holding would carry little weight in any situation other than a court case defining water for the purposes of an insurance policy.

Recognizing that water collects on both the surface and underground is the first step in taking an inventory of water resources in the United States. A closer examination of each of these categories reveals different problems with the various types of surface water and groundwater.

Ocean Water

Water within the United States' boundaries includes ocean water up to the two hundred-mile territorial limit and coastal areas. The 1972 Ocean Dumping Act prohibits the intentional dumping of high-level radioactive substances and chemical warfare agents, as well as substances deemed "harmful" under criteria established by the Environmental Protection Agency. Congress mandated, in P.L. 95-153 and P.L. 96-572, the phasing out of the disposal of all "harmful" municipal sewage sludge and industrial waste disposal. While industrial wastes disposed in the ocean have decreased 52 percent since 1972, municipal sewage sludge has increased 70 percent during the same period.[7] The threat to ocean water is increased by proposals to increase offshore oil and gas drilling, incinerate toxic wastes at sea, dispose of low-level nuclear wastes in the ocean, and mine the seabed.[8] W. F. Grader, executive director of the Pacific Coast Federation of Fisherman's Association, notes that these activities "could all affect the fishing industry from leaks, spills or the disturbance of the ocean bottom and resulting sedimentation. The impacts could range from direct fish kills, to lowered resistance to disease or lowered fecundity, to fish that are unmarketable."[9]

Coastal Water

Most of the concern over the contamination of the oceans centers on the shallow coastal waters near the shore, not the 98 percent of the ocean water in areas over 100 meters deep. There are over 12,380 miles of coastline and 74,364 square miles of coastal waters within the United States according to the *Statistical Abstract of the United States.* This area includes such estuaries as Puget Sound, Long Island Sound, Narragansett Bay, Buzzard's Bay, Chesapeake Bay, and Delaware Bay. Most of these areas possess a fragile ecological system, yet they have been historical dumping grounds for sludge and industrial wastes. The importance of these coastal waters is demonstrated by Congressman Joel Pritchard of Washington:

> Coastal areas in general, and estuaries in particular, represent one of the most valuable portions of our environment. For example, more than 70 percent of the total landings by all commercial fisheries and 65 percent of the recreational catch in U.S. marine waters are of

> species dependent on estuaries during some portion of their life stages.[9]

Specific pollution control strategies are being developed in a four-estuary program with the cooperation of the EPA, the states, and the National Oceanic and Atmospheric Administration.

Wetlands

Some coastal shores and inland areas are characterized as wetlands. Senator Chaffee, chair of the Subcommittee on Environmental Pollution, combined the definitions of the EPA, the Army Corps of Engineers, and the U.S. Fish and Wildlife Service, and offered this conceptualization of wetlands:

> "Wetlands" means land transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Generally, wetlands are areas inundated by surface or ground water frequently enough and for long enough duration to support a prevalence of plants or animals typically adapted to life in saturated soil conditions including but not limited to such areas as coastal or inland marshes or estuaries, river-associated, water-saturated areas, inland lakes, potholes, bogs, mudflats, or bottomland hardwood forests.[10]

It is estimated that 10 percent of the wetlands in the United States are salt marshes and the rest are fresh water. These land-water areas are critical to the survival of fish and wildlife, recreational pursuits, erosion control, flood retardation, water quality, and ground water recharge. Senator John Chaffee indicates that "In all, wetlands contribute from $20 to $40 billion a year to the national economy."[11]

Unfortunately, wetlands are considered prime acres for development. The nation's original 215 million acres of wetlands have been reduced to slightly more than 99 million acres today. This trend is likely to continue as the Office of Technology Assessment (OTA) concludes:

> An estimated 95 percent of all wetland losses are attributed to human activities, as opposed to natural processes of succession; 80 percent of all inland drainage is attributed to agriculture, which, like forestry and ranching, is generally excluded from federal wetland protection laws. Much of this conversion is the result of demand for farm commodities overseas. The OTA report predicts that 400 million acres of new cropland will be needed in the next 20 years, and that wetland conversions will continue.[12]

Other Surface Water

Lakes, streams, and rivers offer other examples of surface waters and are the ones most people consider when the topic of water pollution or water quality is discussed. Various federal and state statutes have been enacted

to control major sources of water pollution such as municipal sewage, industrial wastes, oil, sediment, and excessive heat. Some improvement in water quality has occurred because of statutory requirements for treatment of wastewater. A brief overview of this progress is provided by the Environmental Protection Agency (EPA):

> The best available State and Federal data indicate that the quality of most of the Nation's streams has held constant or improved over the last 13 years despite increases in pollution discharges as a result of the Nation's population and industrial growth. A 1983 assessment of water quality improvements from 1972–1982 conducted by the Association of State and Interstate Water Pollution Control Administrators and the States showed that of 444,000 miles of rivers and streams surveyed, water quality of 47,000 miles of streams, measured against conventional pollutants, improved; 11,000 miles declined, and 297,000 miles showed no major change. Information on 90,000 miles of streams surveyed was not available. Similar trends were reported for lakes.[13]

Despite these advances, more needs to be done to control contamination of drinking water, to clean up toxic wastes, and to reduce pollution from sewage. An increasingly important source of ongoing pollution is from nonpoint sources. Unlike point sources, which are dischargers of waste water from identifiable locations, nonpoint sources are difficult to identify and include runoff from city streets, drainage from farmlands, wastes from mines, and soil erosion from construction. New strategies must be devised to reduce these threats to clean water. As was noted in the *EPA Journal:*

> The basic approach taken by the Clean Water Act for managing point sources—that is, the application of uniform technological controls to classes of dischargers—is not appropriate for the management of nonpoint sources. Flexible, site-specific, and source-specific decision-making is the key to effective control of nonpoint sources. Site-specific decisions must consider the nature of the watershed, the nature of the waterbody, the nature of the nonpoint source(s), the use impairment caused by the nonpoint source(s), and the range of management practices available to control nonpoint source pollution.[14]

Chapter 3 will discuss pollution of surface waters in greater detail.

Groundwater

The bulk of America's water supply lies underground. Approximately 15 quadrillion gallons of water are within one-half mile of the earth's surface. This water is reached by drilling wells and about half of all Americans rely on groundwater as their principal source of drinking water. Agriculture accounts for about 80 percent of the groundwater usage in the United States, while public drinking water accounts for 14 percent.[15]

Groundwater is susceptible to the same sources of pollution as surface water. Geologist David Miller notes:

> Some sources or causes of ground-water contamination involve discharges or contaminants that are wastes or wastewaters. Others involve discharges of contaminants that are not wastes at all but are represented by stockpiles of raw materials or the application of fertilizers and pesticides. Still others are not even discharges but can be due to the infiltration into the ground of polluted river water or the intrusion of salt water into a well because of heavy ground-water pumpage in a coastal area.[16]

However, once this water is polluted, it is very difficult to clean up. A 1984 EPA report indicates:

> Once contaminated, groundwater may be impossible to clean up. It moves slowly—typically only 5 to 50 feet a year—through porous aquifers that may be several hundred feet underground. Plumes of highly concentrated contamination may remain in groundwater aquifers for years. Little is known at this time about the extent of groundwater contamination or the health effects associated with its contamination.[17]

Issues on groundwater contamination and usage will be discussed more fully in Chapter 4.

Federal Government

All three debate resolutions call for action by the federal government. The definition of *federal government* is not controversial to the average person. In ordinary usage, *federal government* refers to the national government, located in Washington, D.C., and its three branches—the Congress, the president, and the federal judiciary. The term *federal government* only becomes an issue in most debates if a negative team offers a counterplan that calls for similar action on the part of each state government. An affirmative team may contend that it is impermissible for a negative team to advocate such a plan because when all fifty states act in unison, they become, in effect, a federal government.

Although this response may have credibility with some judges, there are several arguments that could be used to refute the affirmative's claim. First, even if all fifty states could be called a federal government or part of the "federal system of government," they do not constitute *the* federal government. In addition, legal literature is devoid of any mention of the term *federal government* in reference to similar state action such as adoption of Uniform State Laws or Interstate Compacts. Whenever the term *federal government* is used, it is in reference to the national government.

A better response to the uniform states action counterplan would be an explanation of the reasons why federal or national government action is required. One reason would be that only the federal government has legal jurisdiction over ocean pollution within the 200-mile limit claimed by the United States. In addition, only the federal government has jurisdiction over federal lands. The impact of this federal jurisdiction on pollution control is noted by EPA assistant administrator J. S. Cooper: "The executive branch of the federal government owns 387,396 buildings spread among 27,071 installations, on 729 million acres of land. Many are hospitals, laboratories, manufacturing plants, and other technical installations which generate toxic wastes. If uncontrolled or untreated, these emissions pose the same problems that privately-owned facilities do."[18]

Federalism

This year's problem area seeks to increase the relative power of the federal government over water resources, a position generally opposed by President Reagan. The clash between federal and state interests is reflected in the original debate between Madison and Hamilton on the proper scope of a federal system of government. In *The Federalist* (No. 45), Madison described his view of dominance by the states:

> The powers delegated by the proposed Constitution to the federal government are few and defined. Those which are to remain in the state governments are numerous and indefinite .... The powers reserved to the several states will extend to all the objects which, in the ordinary course of affairs, concern the lives, liberties, and properties of the people, and the internal order, improvement, and prosperity of the state.[19]

Hamilton, however, relied on the general welfare clause to argue for broader powers for the federal government: "The phrase is as comprehensive as any that could have been used because it was not fit that the constitutional authority of the Union, to appropriate its revenues, should have been restricted within narrower limits than the general welfare, and because this necessarily embraces a vast variety of particulars which are susceptible neither of specification nor of definition."[20] Hamilton's position was accepted by the Supreme Court in the 1930s and is the basis for extensive national involvement in economic and regulatory programs.

Under the Reagan administration there has been a renewed emphasis on state responsibility for domestic programs. At the same time, there is concern that the federal government will reduce its financial commitment for mandated programs, shifting this burden to the states. Traditionally, federal government involvement in domestic issues was justified on the basis that it was the only level of government with the resources sufficient to eliminate program disparity between states when problems crossed state boundaries or required a national minimum level of effort. The

states, it was claimed, had weak tax structures, inefficient administrative practices, and parochial orientations. The advantageous aspects of state action included such ideas as the states were closer to the people, were better able to respond to the people's true needs with a minimum of red tape, and were more likely to develop innovative approaches to solving problems. These general principles formed the basis of the early environmental legislation. Alvin Alm, deputy administrator of the EPA, explains the common perception of state capabilities in the early 1970s:

> When the major environmental laws were passed in the 1970s, the Congress observed that states had uneven and, in some cases inadequate, capability to undertake aggressive, effective environmental protection programs. Legislators felt, too, that some states might be motivated more by economic rivalry than by the environmental ethic, and that the resulting competition would threaten the national cleanup that most considered essential. Consequently, these laws assigned to the federal government, in the institution of EPA, most of the key functions involved in the design and delivery of environmental services. Where states were involved, they were assigned carefully circumscribed functions.[21]

John Grand, program manager for Environment and Natural Resources for the Council of State Governments, notes the shifting intergovernmental relationships during the fourteen years of the modern environmental movement:

> The 1970s were characterized by expanding fiscal, legislative and program commitments to the protection and enhancement of the nation's land, air and water resources. Backed by strong legislation and grant dollars, the states expanded their programs in a variety of environmental areas. The state role, as envisioned in the legislation and as it actually evolved, was to take the lead in program implementation and enforcement with the federal government providing technical assistance, program oversight and enforcement backup. Within the context of a nationally defined set of goals and standards, the states were free to develop programs to solve their individual environmental problems.
>
> However, at the beginning of the 1980s, the intense interest in and support of environmental programs at the national level began to wane. Under the guise of a New Federalism both the federal role and the available federal dollars to support state programs diminished with no concurrent decrease in mandated state activities. The result was the gradual overburdening of state resources and capabilities in environmental management.[22]

The states have evolved into a primary role in environment management. Lewis Crampton, director of the EPA Office of Management Systems and Evaluations, notes:

> States have progressed so far in the past thirteen years that they are now the primary operational arm of a national network for environmental protection. States should concentrate on direct administra-

> tion of environmental programs, including permit and compliance activities. EPA should focus on national standards and research, technical support and oversight for state programs, and accountability to the President and the Congress for national environmental progress. Of course, EPA must stand ready to step in to support states in essential areas like enforcement if persistent problems keep the state from carrying out its full responsibility.[23]

The reasons for a greater emphasis on the states is not due solely to the ideological leanings of the current administration. There are sound fiscal and managerial justifications for this change. One reason is that the states are better able to handle funding requirements. Carl Stenberg, executive director of the Council of State Governments, notes:

> Austerity measures, tax hikes and the national economic recovery have improved the fiscal condition of many states and turned budget deficits into surpluses. In contrast, the federal government has become the big spender as well as the big borrower in the public sector. Mounting federal deficits have bolstered efforts to discipline federal fiscal decision-making through a balanced budget amendment to the Constitution and other means.[24]

States are also more capable of effective and equitable governance. Stenberg claims that "the reformers' checklist has been achieved in most states: constitutions have been simplified; governors and legislatures have been strengthened, executive branches have been streamlined; and court systems have been modernized."[25] Table 1 more clearly demonstrates the specific organizational formats for state environmental management.

Despite the improved ability of most states to meet the challenges posed by the development of successful water policies, a federal role remains necessary to enforce interstate laws and to provide financial assistance. The cost of environmental cleanup is enormous. According to an EPA needs survey, "the capital investment required to meet water quality goals through construction or rehabilitation of wastewater treatment plants will be $19 billion between 1980 and the year 2000. The costs of financing the repair and replacement of urban water supply and treatment facilities are equally staggering: ranging from $80 to $115 billion by the year 2000."[26] It is doubtful that states and localities could afford such an effort. Jon Grand concludes:

> Even with savings through more efficient program administration, individual states are unlikely to have the financial resources to substitute for federal funds. Federal money has supported technical staff, planning and research activities, and basic environmental management programs. States have depended upon federal agencies and federally sponsored research for data gathering, issue analyses and technical assistance. Reductions in federal direct and indirect assistance, combined with revenue and spending limitations in the states,

Table 1

STATE ENVIRONMENTAL ORGANIZATIONS

State	Date of reorganization	Health department(a)	Little EPA(b)	Environmental super agency(c)	Partially consolidated or nonconsolidated agency	Citizen environmental council/ commission
Alabama	1982	...	...	•	...	...
Alaska	1971	...	...	•	...	...
Arizona	...	•	...	...	...	•
Arkansas	1971	...	•	...	...	...
California	1975	...	...	...	•	...
Colorado	...	•	...	...	...	...
Connecticut	1971	...	...	•	...	...
Delaware	1970	...	...	•	...	...
Florida	1969	...	•	...	...	...
Georgia	1972	...	...	•	...	...
Hawaii	...	•	...	...	...	•
Idaho	1972	•	...	...	...	...
Illinois	1970	...	•	...	...	...
Indiana	...	•	...	...	...	...
Iowa	1972	...	•	...	...	...
Kansas	1974	•	...	...	...	•
Kentucky	1973	...	...	•	...	•
Louisiana	1982	...	...	•	...	•
Maine	1971	...	•	...	...	...
Maryland	1969	•	...	...	...	...
Massachusetts	1969	...	...	•	...	...
Michigan	1973	...	...	•	...	...
Minnesota	1967	...	•	...	...	...
Mississippi	1979	...	...	•	...	...
Missouri	1974	...	...	•	...	•
Montana	1971	•	...	...	...	•
Nebraska	1971	...	•	...	...	•
Nevada	1975	...	•	...	...	•
New Hampshire	1980	...	•	...	...	•
New Jersey	1970	...	...	•	...	...
New Mexico	1971	•	...	...	...	...
New York	1970	...	...	•	...	...
North Carolina	1977	...	...	•	...	•
North Dakota	...	•	...	...	...	...
Ohio	1972	...	•	...	...	...

(continued)

Table 1 (Continued)

State	Date of reorganization	Health department(a)	Little EPA(b)	Environmental super agency(c)	Partially consolidated or unconsolidated agency	Citizen environmental council/ commission
Oklahoma	...	*	...	...	...	...
Oregon	1969	...	*	...	...	...
Pennsylvania	1970	...	...	*	...	...
Rhode Island	1977	...	...	*	...	*
South Carolina	1973	*	...	...	...	...
South Dakota	1981	...	...	*	...	...
Tennessee	...	...	...	...	...	*
Texas	...	...	...	...	*	...
Utah	...	*	...	...	...	...
Vermont	1970	...	...	*	...	...
Virginia	...	...	...	...	*	...
Washington	1971	...	...	*	...	...
West Virginia	...	...	...	...	*	...
Wisconsin	1967	...	...	*	...	...
Wyoming	1973	...	*	...	...	*

Key:
*—Yes
...—No

(a) Health Department Model: 15 states currently include their pollution control programs within their state health or health and human resources department. While a few states have chosen explicity to consolidate their previously fragmented pollution control programs within a reorganized health department, in most states this model represents the historical relationship between environmental protection programs and public health considerations.

(b) Little EPA Model: 12 states currently have what might be called little EPAs because they mirror the U.S. Environmental Protection Agency in their program responsibilities.

(c) Environmental Superagency Model: 19 states consolidate their pollution control functions into an environmental superagency, defined as the inclusion of the three major pollution control programs with at least one other state conservation or development program.

From: *The Book of the States 1984–1985*, Council of State Governments, 1984.

> cast uncertainty on the ease with which states can assume expanded responsibilities to manage and enforce environmental programs.[27]

Additional information on the specific role of federal and state governments will be provided in the following chapters as the major issues of water quality and water allocation are addressed.

Interstate Compacts

The United States Constitution offers a unique organizational format for solving problems that cross state boundaries. Interstate compacts establish permanent arrangements among the states to deal with functional problems such as nuclear energy, resource management, and pollution and hazardous waste control. The technical and legal details of such agreements are explained by the Council of State Governments:

> A compact is a statute in each state and a contract between states subject to the Constitutional enforcement of contracts. When a state adopts a compact, it cannot impair the obligation of the contract or unilaterally renounce the interstate compact except when the party states agree. As contracts, interstate compacts take precedence over state laws that conflict with their provisions. These characteristics make interstate compacts the most binding legal instrument to establish formal cooperation among states.[28]

Some recent compacts, including the Delaware River Basin Compact and the Susquehanna River Basin Compact, have even included the federal government as a party to the agreement. This unique approach to solving interstate problems offers an alternative within the federal system to a forced choice between the federal and the state levels of government. Most issues that will be considered under the general area of water resources could be covered by possible interstate compacts.

International Efforts

Just as environmental and water resource issues cross state boundaries, such problems also cross national boundaries. For example, United States decisions on water policy in the Southwest will effect possible water utilization in Mexico. Pollution in the Great Lakes, the St. Lawrence Seaway, or Puget Sound also degrades the quality of Canadian waters. Acid rain, produced by industries and utilities burning coal and oil on the East Coast, falls on streams, lakes, and rivers in both the United States and Canada. Lynton Caldwell, professor of Public and Environmental Affairs at Indiana University, cites examples of new international treaties, such as the 1979 Bonn Convention on Conservation of Migratory Species of Wild Animals, the 1983 International Treaty on Long-Range Transboundary Air Pollution, and the 1971 Convention of

Wetlands of International Importance, which have been enacted to promote international cooperation on environmental issues. In addition, older agreements have been revitalized.

> For example, the Boundary Waters Treaty of 1909 between Canada and the United States has been applied to a growing number of environmental issues. Implementation of this treaty and the Great Lakes Water Quality Agreements of 1972 and 1978 has been expedited by the binational International Joint Commission. Although much remains to be done to improve the quality of water in the Great Lakes, some tangible progress has occurred. Water quality agreements between Mexico and the United States have resulted in the construction of a large desalinization plant on the lower Colorado River—a necessity not contemplated when the 1945 treaty between the two countries was ratified.[29]

There is also concern that if environmental regulations become too strict in the United States, multinational corporations (MNC) will relocate in lesser developed countries with weaker laws. Thus, the problems of pollution will be intensified. The parameters of this discussion have been outlined by Professor Royston of the International Management Institute in Geneva, Switzerland:

> Over the last 10 years, arguments have ranged over the proper environmental role of MNCs, particularly those in less developed countries (LDCs). On one side there are those who believe that MNCs deliberately seek out "pollution havens" so that they can be free from costly pollution control legislation. On the other side there are those who claim that the command of advanced technology by MNCs will lead them automatically to install modern and clean plants.[30]

Royston concludes that recent studies indicate that "there is little evidence that MNC's behave worse than local industries, and that, in fact, there is a good deal of direct and circumstantial evidence that MNC's have a better record."[31] He also notes:

> As many studies have pointed out, the decision on where to locate a plant is determined by accessibility of the proposed site to markets, raw materials, energy, and labor—all of which have a major influence on costs—and never by the existence of reduced pollution control requirements, the costs of which are financially relatively negligible. In short, the way MNCs behave abroad depends on political and social pressures: the spectrum ranges from acting as they would at home to behaving quite differently while still conforming to local legal requirements.[32]

Finally, this need for international cooperation offers a unique justification for involving the federal government instead of the states. The Constitution delegates to the federal government the exclusive authority to represent the United States in international affairs. To the extent that

water policies have an impact across national boundaries, federal jurisdiction is most appropriate.

Market Forces

In an era of deregulation, the issue of reliance on free market forces as an alternative to government regulation has received attention. Government regulations typically require certain conduct (such as reduction of pollutants or water conservation) and punish corporations or people who violate the requirements with civil fines, criminal fines, or imprisonment. Market solutions to water problems, on the other hand, attempt to create economic incentives for consumers and industries to take the action desired.

Reliance on market forces would be a possible solution to a water shortage. Under a pure free market scheme, the government would not become involved in allocating water to users it deemed high priority. Instead, it would rely on the law of supply and demand. If more water was demanded at the existing price than was presently being supplied, purveyors of water would raise the price. As water prices increased, users would be more inclined to cut back their utilization of water, particularly if they did not have a compelling need for all the water they currently used, or develop more efficient methods for utilizing existing resources. Consumers may decide to water their lawns less often or take shorter showers if they were faced with a sudden increase in water bills. The existence of a higher price would also motivate suppliers to supply more water. Techniques for making water potable that were once too expensive could be affordable when the provider obtained a higher price. Suppliers may also be able to exploit new sources of water that were once too costly to use.

Free market remedies to pollution have also been suggested. One program is effluent fees. Under an effluent fee system, each polluter is charged a fee for each unit of pollution it discharges into the water. This plan can be economically efficient because it encourages polluters who can clean up least expensively to do the most pollution abatement. If a firm's cleanup costs are less than its effluent fees would be, the firm will install pollution control technology. If the cost of abatement is very expensive for a company, it will pay the effluent fees instead. In theory, the fees can be set at a level that would insure the socially optimal amount of pollution control. At this fee level, the amount of money polluters spend on pollution control would equal the dollar value to society of benefits from pollution control.

A similar effect to effluent fees can be obtained through a permit system. Under this system, each polluter would be given a permit to allow some limited discharge of pollutants. Firms would be free to sell some or

all of their pollution permits to other companies. A firm that faced a very high cost of pollution reduction would have an incentive to buy permits from firms who did not need the permits as badly because their cleanup cost was less. Just as with effluent fees, a major advantage of a permit system when compared to across the board regulations is that much of the effort toward controlling pollution is expended by the companies which can institute such controls cost-effectively.

Summary

This chapter has concentrated on some of the common issues shared by all three debate resolutions under the water resources topic. The next chapter will examine the issues associated with water pollution that involve the potable water and water quality resolutions.

3. Water Quality

Resolved: That the federal government should establish a comprehensive national policy to protect the quality of water in the United States.

Resolved: That the federal government should establish a national policy to insure each United States resident an adequate supply of potable water for personal use.

Basic Concept

The water quality proposition under the general problem area of United States water policies focuses on federal efforts to reduce water pollution. This topic will probably be the topic selected by most states and summer forensic institutes. The potable water topic is related to both the water quality topic and the water allocation topic. The term *potable* means "suitable for drinking."[1] Suitable drinking water could be construed to include water free of pollutants. Thus, cases under the water quality resolution that are discussed in this chapter could also be run on the potable water proposition. Debaters could also focus on the "adequate supply" phrase of the potable water topic and use the plans discussed in Chapter 4 as mechanisms to allocate potable water to each United States resident. Key definitions of terms in both of the above topics will be discussed first in this chapter. The definitions will be followed by an analysis of the water quality resolution; however, it should be remembered that most issues dealing with the quality of water for personal use can also apply to the potable water topic.

The definition of water quality relates to the levels of specific substances present in water, including chemicals and bacteria.[2] The word *quality* implies a level of excellence, thus a water quality policy should strive to keep water reasonably safe. Water quality standards focus on end results rather than on specific pollution sources. This distinction was drawn by the Wisconsin Supreme Court in the cast of *Wisconsin Electric Power Co. v. State Natural Resources Board:*

> "Effluent limitations" measure the discharge of pollutants at the source, while "water quality standards" measure the quality of the given body of water without focusing on any single polluter."[3]

The water quality resolution calls for the United States to establish a policy. One definition of establish is "found," as in establishing a settlement. Negative teams will be likely to use such definitions against plans that improve existing clean water regulations rather than instituting completely new ones. However, establish can also mean "make firm or stable" or "put on a firm basis." Under these definitions, a plan could strengthen present laws or institute new ones.

The exact nature of a comprehensive policy has always been difficult to specify. Dictionaries define *comprehensive* as "inclusive" or "thorough," but that does not help one to decide how much a policy must do to be classified as comprehensive rather than as limited. Affirmative teams attempting to limit their analysis to one or two aspects of water pollution will want to argue that it is the policy that must be comprehensive, rather than the effect of the policy. Thus, as long as a plan includes all the necessary elements of good legislation (such as a mandate, funding, and enforcement), it need only implement standards for some minimum number of pollutants. This interpretation may not be as viable under this topic, however. The fact that a national policy must be established supports the argument that an affirmative must deal with pollution across the United States. Any good affirmative plan will include all provisions essential to its workability, regardless of whether the topic requires a comprehensive policy. The word *comprehensive* would not have been added to the resolution if the intent was merely to require what most debaters would include anyway.

The potable water topic also raises some definitional issues. Ensuring an adequate water supply places some burden on the affirmative. *Insure* means "to make certain."[4] Thus an affirmative team cannot merely improve the chances of all Americans getting potable water. Water availability must be guaranteed. Water for personal use goes beyond drinking water: it includes other human needs such as cooking or bathing. The question of what constitutes an "adequate supply" may also be debated. *Webster's* Dictionary defines *adequate* as "sufficient for a specific requirement."[5] Because the requirement of this topic is water for personal use, affirmatives must ensure a water supply that is sufficient for all personal uses. Alan Hess, John Dyksen, and Howard Dunn provided evidence of how the issue of potable water goes hand in hand with the water quality issue:

> The continued use of groundwater as a potable supply depends on our ability to meet the challenge of maintaining water quality parameters of concern at acceptable levels.[6]

The next section of this chapter will discuss the studies that have attempted to determine whether or not current levels of water pollution significantly affect human health.

Studies on the Effect of Water Pollution

Studies Linking Water Pollution to Health Harms

Many researchers have found a link between water pollution and cancer. Twenty years ago, Doctors Hueper and Payne warned that the rapidly increasing pollution of water by carcinogenic agents "has created conditions that may result in serious cancer hazards to the general population."[7] One commentator has suggested that "with the cancer rate in America at its highest level ever, Drs. Hueper and Payne appear to have been proven correct."[8] The National Cancer Institute has identified twenty-three chemicals commonly found in small amounts in drinking water as carcinogens or suspected carcinogens.[9] Another general study was done on treated water from the Mississippi River, in which toxic organic pollutants were identified. Significant correlations were shown to occur between treated drinking water and total cancer mortality in white males, nonwhite males, and nonwhite females.[10]

Specific chemicals have also been linked to cancer. One such chemical is dioxin. According to an EPA report, "one can expect a dioxin related cancer to develop for every 100,000 persons who consume drinking water contaminated at concentrations of 2.2×10^{-6} micrograms per liter."[11] Another suspected carcinogen is trihalomethane. One study of 76 counties found statistically significant correlations between bladder cancer mortality rates and trihalomethane levels.[12] Chloroform has often been cited as a cancer-causing agent. Lewis Regenstein has stated:

> Twelve separate scientific studies conducted since 1974 have linked chemical levels in drinking water to cancer mortality rates. In one study of 77 cities, chloroform levels were associated with death rates from cancer of the pancreas. Studies conducted by the National Cancer Institute and the National Institute of Environmental Health Sciences indicate that chloroform residues in drinking water at levels as low as 100 parts per billion could increase cancers of the bladder by 30% and cancers of the rectum and colon by 4 to 6%.[13]

Cancer is not the only disease associated with water pollution. One study investigated the relationship between contaminated wells in Woburn, Massachusetts, and childhood illness. The EPA discovered high concentrations of the industrial solvent trichloroethylene and tetrachloroethylene in two of the town wells. Harvard researchers Zelen, Lagakos, and Wessen obtained the medical histories of 6,000 town residents. Their study revealed associations between the contaminated water and birth defects, perinatal deaths, childhood leukemia, lung and kidney disorders, and allergies. Most disturbing was the incidence of childhood leukemia, which was nearly three times the national rate.[14]

Water can also lead to heart disease when it contains excessive sodium. Some water systems contain eight times more sodium than the American

Heart Association recommends as a maximum for people with heart conditions or high blood pressure.[15] A report by the Council on Environmental Quality stated that toxic chemicals in drinking water "can cause such health problems as tremors, blindness, nausea, dizziness, skin eruptions, and impairment of the central nervous system."[16]

Water that contains very minute quantities of pollutants can still be dangerous. Even at concentrations of ten parts per billion, many toxic organic chemicals pose serious, irreversible health risks.[17] It is also possible that only the tip of the iceberg is visible when it comes to pollution harms. In almost every case studied to date, only a few of several hundred possible compounds were actually tested.

Evidence That Water Pollution Does Not Cause Major Harms

There is evidence that affirmatively states that water quality is not a major cause of health problems. One paper compared the city of St. Louis to suburban St. Louis county to see if water quality explained the higher death rates in the city. It concluded that "associations existed between cancer mortality rates and air pollution, income, education, and percent [of] unskilled workers, so that drinking water did not appear to be necessary to account for the higher death rates."[19] The National Research Council was commissioned by the EPA to review ten studies and it concluded that it was not possible to establish a link between the presence of trihalomethanes or synthetic organic chemicals normally found in drinking water and cancer in humans.[20] Even if sufficiently high concentrations of pollutants may be hazardous, it can be contended that pollutants are not harmful at the level they are actually found in water. Water quality consultant John Gaston argued:

> If contamination is found the levels are likely to be fairly low—part per billion range—and the lifetime risk from ingestion low. Rarely have situations involving acute hazards been found.[21]

A *New York Times* report on the cancer threat posed by synthetic chemicals found that "repeated alarms raised over such chemicals have given the public an exaggerated notion of how responsible these chemicals are for the nation's cancer problems."[22] The article, based on interviews with more than two dozen cancer and health experts, concluded that commercial and industrial cancers cause less than ten percent of the nation's annual cancer deaths. Another source has given an even lower figure, stating that "air and water pollution account for only two percent of known cancer causes."[23] However, it should be noted that in a nation where cancer deaths total in the hundreds of thousands, even 2 percent of all cancer deaths comes to 4,000 to 5,000 deaths per year.

Possible Problems With Studies Linking Water Pollution to Harms

A very debatable issue on the question of water pollution's health consequences is the validity of studies linking water pollution to adverse health effects. Two major types of studies are generally used—studies on laboratory animals following ingestion of the pollutant in question, and epidemiological studies. Epidemiological studies attempt to compare a group of people who have consumed polluted water with a "control group" of similar people whose water is not polluted.

One major source of information on the health effects of water pollution is the standards set by the Environmental Protection Agency. These standards establish the levels of pollution below which no adverse health effects have been observed. All these standards were based on animal studies.[24]

There are problems with such studies. First, the animals are exposed to large doses of suspect substances, sometimes in ways that are different from the way that humans would come in contact with the substances, to determine if a cancer develops.[25] In addition, some substances are hazardous to laboratory animals, but do not have the same effects in humans. For example, nitrosamines have been described as the most potent carcinogen ever used in an experimental laboratory, yet they show no evidence of inducing cancer in humans.[26]

Attempts to rely on studies of actual human populations are also problematical. A shortage of completed epidemiological studies exists; with people exposed to some 70,000 synthetic substances, many of which find their way into the water system, studies on large numbers of the substances cannot be completed in a reasonable length of time, according to the National Research Council.[27]

Even when the studies are done, the results are not necessarily conclusive. Abel Wolman, a professor emeritus at Johns Hopkins University and advisor to organizations such as the World Health Organization and the World Bank, has written:

> Many contradictions regarding the effects of trace elements appear in the vast literature. The findings are non-specific and inconsistent. Definitive conclusions are a long way off with respect to physiological impact of sodium, potassium, magnesium, cadmium, selenium, and many other elements.[28]

Selenium provides a good example of the difficulties encountered in analyzing possible pollutants. Although considered to be a major toxic element, the lives of 17,000 Chinese children were recently reported as saved by the addition of selenium to the water.[29] A current example of uncertainty in studies is the effort to determine the effect of drainage waters from farmlands in central California on the Kesterson National Wildlife Refuge and adjacent water district. State officials report that the

effort is "so riddled with conflicting laboratory results [that] it is of little value in determining whether four crops contain safe levels of selenium, chromium, and nickel."[30]

There are also questions of whether epidemiological studies of water pollution's effects can be done accurately. Cancer takes a long time to develop after an exposure to a cancer-causing agent—ten, twenty, thirty, or even sixty years may possibly elapse.[31] Thus, to study whether or not exposure to polluted water in a given city in 1950 caused people to contract cancer, one would need to find a large enough group of people who died of cancer from 1970 to 1980, and who lived in that city around 1950. Almost all of the epidemiological studies that have linked drinking water to cancer mortality did not have data on how long the cancer victims had lived in the area where the water was polluted.[32]

In addition, a study should make use of a control group. A control group is a set of people who are similar to the population whose water is polluted, but who have not been exposed to the pollution. If the group drinking polluted water develops cancer or other diseases while a similar group whose water is not polluted does not, the case for linking such diseases to the drinking water is much stronger. Unfortunately, epidemiological studies have generally not been able to make use of a control group.[33] This problem came up when efforts were made to study Love Canal residents, whose blood was analyzed for synthetic chemicals. However, a group of volunteers who were supposed to serve as an unexposed control group was found to have measurable blood levels of many of the same chemicals.[34]

Even when a population exposed to polluted water develops a higher incidence of some disease, it cannot be confidently stated that the pollution caused the disease. Long-term, chronic diseases have been linked with many different potential causes, including diet, smoking, alcohol, chemicals in the workplace, and air pollution. Many argue that smoking, alcohol, and diet far outweigh pollution in causing cancer.[35] If a study does not take these factors into account, one cannot be confident of a link between water quality and health. Unfortunately, the data used in epidemiological studies often lack occupational, dietary, or smoking histories.[36]

The Impact of Uncertainties Surrounding Present Studies

Many people feel that action should be delayed on potential environmental hazards until definitive studies are completed, and it can be reasonably ascertained that a given pollutant is harmful enough to warrant regulation. Certainly a strong argument can be made that definitive studies have not yet been done, but the conclusion to be drawn from that argument is debatable. On the one hand, in an era of limited resources, it is wise to be

cautious about committing large sums of money to problems that may not even exist. On the other hand, however, the issue is the protection of human health. As the number of pollutants in water increases, the risk that these substances will eventually cause disease and death mounts. It can be argued that society should err on the side of safety when dealing with public health. Thus, while authorities note the problems with existing studies, they also support further government action against water pollutants.[37]

Present System Efforts to Reduce Water Pollution

Major Federal Legislation Related to Water Pollution Control

The Federal Water Pollution Control Act (FWPCA) or "Clean Water Act" prohibits any point source from discharging pollutants into the navigable waters of the United States unless that source has a National Pollutant Discharge Elimination System (NPDES) permit.[38] Point sources are discharges of wastewater that typically come from an identifiable location, such as a pipe from a factory that dumps used water into a lake. Point sources can be contrasted with nonpoint sources, which are those pollution sources that are hard to identify and are often widely distributed. An example would be pesticides that are applied to hundreds of farm acres, and then run off into a river after a storm. Navigable waters have been interpreted to mean almost every significant body of water in the nation.[39] Most of the regulation under the Clean Water Act has dealt with surface waters and the pollutants commonly found in them.[40]

Although the FWPCA theoretically creates a joint state-federal effort, most of the ultimate program control rests with the U.S. Environmental Protection Agency. The EPA has the power to set uniform water pollution standards and the EPA initially administers the NPDES permits. A state may only administer its own program by establishing a program that conforms to the EPA's standards (or sets more stringent standards). If the EPA believes a state is not enforcing its program adequately, it can ask the state to take action or the EPA can initiate its own court proceedings.[41]

The stated goal of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters by eliminating the discharge of all pollutants into navigable water by 1985."[42] It has been noted by some commentators that this law set lofty and unrealistic goals to dramatize environmental issues and show polluters that the government meant business.[43]

The FWPCA is enforced through penal sanctions. Any person violating a permit is subject to civil penalties of up to $10,000 per day as well as criminal penalties for willful or negligent violation of any permit.[44]

The Safe Drinking Water Act is another major piece of federal legislation dealing with water pollution. It attempts to regulate pollution in water supplied by public water systems. Under this act, the EPA sets national regulations for drinking water. These regulations may either set maximum permissible levels of contaminants or require particular treatment techniques.[45] When setting these standards, two potentially conflicting goals must be taken into account. On the one hand, standards "shall protect health to the extent feasible, using technology, treatment techniques, and other means, which the [EPA] administrator determines are generally available (taking costs into consideration)."[46] At the same time the EPA is to look at technical capability and potential expense, the standards are supposed to be set at a level which "no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety."[47] The standards are to be revised whenever changes in technology, treatment techniques, and other means permit greater protection of the people's health.

The division of state and federal authority under the Safe Drinking Water Act is similar to that under the FWPCA. A state has primary enforcement responsibility if the state regulations are no less stringent than the federal ones and adequate enforcement is provided.

Other pollution control acts attempt to prevent toxic chemicals from reaching the water in the first place, rather than using technology to clean up the water after it has been polluted. The Comprehensive Environmental Response, Compensation, and Liability Act created the Superfund. The Superfund program created a $1.6 billion fund "to help pay the costs of cleaning up the Nation's hazardous waste dumpsites, and of responding to spills or releases of hazardous substances."[48] The program is largely financed by a tax on crude oil, imported petroleum products, and chemical feedstocks. The Superfund tax will terminate on September 20, 1985, and would need new revenues to continue in operation during fiscal year 1986. Thus, it will be important to follow the congressional and presidential actions on any proposed extension or amendment of the Superfund this fall.

The Toxic Substances Control Act (TSCA) proposes another method for controlling hazardous chemicals before they reach the water supply. Under the TSCA, "no person may manufacture a new chemical substance for a new use without obtaining clearance from the EPA."[49] A major goal of this program is to establish a procedure for estimating the hazard to human health and the environment before widespread use of a new chemical occurs.

The EPA administers the TSCA. After looking at the data, the administrator must evaluate the degree of risk associated with the extraction, manufacture, distribution in commerce, processing, use, and disposal of the chemical substance. If the chemical presents an unreasonable risk of

injury, the EPA administrator may restrict or ban manufacture and use of the substance.[50]

Finally, under the Resource Conservation and Recovery Act, the EPA "has developed national standards for proper 'cradle to grave' management of hazardous waste, that is, from the moment it is generated to its ultimate disposal."[51] Under this act, EPA regulations require hazardous waste generators and transporters to register. Operators of hazardous waste treatment, storage, and disposal facilities must obtain a permit. Design and operational standards for treatment, storage, and disposal facilities are created. In addition, there are financial standards to assure that funds are available to close the disposal facility properly, pay for the cleanup of the environment, or reimburse those who are harmed by contamination from the facility.[52]

Arguments that Present Laws Are Not Solving Water Pollution Problems

Although the letter of the laws just described seems to create sound mechanisms for the control of water pollution, in practice, their effectiveness is not necessarily sufficient. There is substantial evidence that current water pollution control efforts are not making enough progress. Since the Safe Drinking Water Act was passed, the EPA has only adopted standards for twenty water contaminants, most based on the 1962 recommendations of the U.S. Public Health Service, in spite of growing evidence of other contaminants present in drinking water.[53] Compliance with the Clean Water Act is far from uniform. A Government Accounting Office (GAO) study of 531 major wastewater dischargers led them to estimate that 82 percent of the 274 municipal and 257 industrial dischargers exceeded their monthly average permit limits at least once during the eighteen months between October 1980 and March 1982.[54] There are close to 800 national priority sites on the Superfund list and the EPA's own estimate is that 6,000 sites will ultimately demand response from the fund. Only six sites have been completely cleaned up.[55] *The Journal of Criminal Law and Criminology* provided one possible reason for minimal enforcement:

> The Reagan Administration has dramatically altered the federal water pollution effort. Pursuing economic recovery through deregulation, the Reagan Administration in its first six months has taken strong measures to reduce the burdens of pollution control regulations on the economy. With decreased environmental regulation, it is unclear whether the new federal effort can prevent significant deterioration of the nation's waters.[56]

L. Chou and K. B. Carter give other reasons federal laws are not adequately effective:

- The NPDES program depends on self-monitoring by dischargers.

- Funds allocated for developing and implementing programs under major environmental legislation declined by 30 percent from 1981 to 1984.
- When the EPA determines that a fine is warranted, the case is referred to the Justice Department, leading to expensive delays.
- Many discharge permits only deal with conventional pollutants and do not control toxic contaminants.[57]

Even if a company is convicted for pollution control law violations, compliance with the law may not be forthcoming. Fines imposed have not been sufficient to deter corporations from violating the FWPCA because it would cost more to implement pollution control devices than to pay the fines resulting from criminal convictions.[58]

Arguments that the Present Laws Are Appropriately Utilized

Not all of the evidence suggests that the present system is inadequately dealing with water pollution. Although the federal budget is being cut in many areas, the EPA will see its budget raised by $200 million to $4.6 billion for the financing of more investigations of hazardous waste problems.[59] The EPA has also proposed a new plan to speed up removal of hazardous waste and toxic substance spills without having to go through a long, expensive planning process as is required by current operating procedures.[60] A tougher approach to violations may be implied by the EPA's action to obtain a $6.8 million toxic waste penalty against one company—the largest penalty in EPA history.[61]

There may also be some cogent reasons as to why water pollution programs are not proceeding faster. It takes time for the industry and government regulators to learn to work together in complying with the laws. Former EPA Administrator William Ruckleshaus, commenting about the Superfund, contended: "I'm not sure we could have got the system to where it is now any faster than if we had twice as many people."[62] The EPA and Office of Technology Assessment have said that at a maximum, the most money they could possibly spend efficiently for toxic waste cleanup would be a billion dollars a year.[63]

There is not a unanimous consensus that present laws are inadequate to solve pollution problems. Congressman Stephen Solarz argued:

> The Clean Water Act already contains clear-cut requirements for ending raw discharges, and adequate sanctions, both civil and criminal, for compelling compliance with those requirements."[64]

If government action is not sufficient, citizens can sue if they are harmed by water pollution. In one New Jersey case alone, a judge ordered officials of Jackson Township to pay ninety-seven families nearly $16

million in compensation for cancers and other illnesses linked to contaminated drinking water.[65]

The Future of Water Pollution Control Laws

The entire structure of the government's water pollution control effort could change. Many of these programs need to be reauthorized in 1985. Environmentalists could take satisfaction in the fact that President Reagan signed the Resource Conservation and Recovery Act reauthorization; however, the Clean Water Act, Safe Drinking Water Act, Toxic Substances Control Act, and Superfund were not renewed during the 98th Congress.

If prospects for renewal depend on who has political clout, these programs may be in trouble. Amy Maron and Camille Pisk have contended that

> powerful lobbying by the Reagan administration and corporate interests. . .have led to the defeat of such bills as Superfund and the Clean Water Act.[66]

At the same time that corporate power is increasing, the environmental movement may be losing some steam. Former Wilderness Society lobbyist David Foreman argued that "too many environmentalists have become bureaucrats, 'weak from sitting behind desks; co-opted by too many politicians.' "[67]

Possible Case Areas

Strengthen Water Pollution Control Laws across the Board

A case could take a comprehensive approach to the water pollution problem by mandating the elimination of water pollution from all sources to the greatest extent feasible. A plan taking this approach would add more pollutants to the list of those currently proscribed. It would probably increase inspections to check for violations of the law and increase the penalties so that polluters would risk more by disobeying regulations. Such a plan would make sure that pollution would not occur if it posed any threat to human health.

There is good evidence that this general approach would be successful. Rather than relying on the polluter to voluntarily report violations, compliance sampling inspections could be done. Such inspections utilize an independent sampling and analysis of the discharger's effluent and thus directly test the accuracy of data submitted by a discharger.[68]

A comprehensive solution would focus on both the protection of water from contamination and the treatment of polluted water. Techniques exist for reducing the level of pollutants in water. To prevent pollution

from occuring in the first place, there are monitoring systems to detect stray pollutants before they cause widespread harm. Once the source of pollution is discovered, hydrologists can determine where and how to build bulwarks to contain or divert plumes of contamination.[69] More could be done to keep hazardous wastes from reaching drinking water. Abel Wolman has written:

> Industrial chemical processes should approach closed cycles as much as possible. Disposal of residuals requires elimination of their return to the environment in toxic form. These efforts include in situ changes in production and waste recovery; changes acceptable for landfill; hazard removal by thermal, chemical, or biological means; waste immobilization; disposal at sea; or secure storage of wastes.[70]

If water does become polluted, the technology exists to reduce the pollution. According to Wolman:

> We can remove parts per quadrillion without great leaps in technology. The cost of potable water is very low in the U.S. and economical techniques are either in use or being developed here and in Europe for removing organic chemicals to nondetectable levels.[71]

Environmental health engineer J. E. Tiernan provided some examples of technology that could be utilized:

> A previous literature review showed the ability of major water and wastewater treatment processes to remove or decrease the EPA consent decree priority pollutants, most of which are known or suspected carcinogens and mutagens. It was determined that lime coagulation, sedimentation, and mixed media filtration could remove 67% of the consent decree priority pollutants (a total of 45%) by greater than or equal to 30% efficiency; and it could remove 31% of the consent decree priority pollutants (a total of 21) by greater than or equal to 90% efficiency.[72]

Other technology that can upgrade wastewater at a level of quality appropriate for human consumption includes air stripping and granular activated carbons (GAC). Air stripping runs water through a column with packing, which provides a large surface for water contact and allows the organics to be stripped from the water into the atmosphere, where there is only a remote chance that they will cause pollution. Granular activated carbons are used to remove dissolved organic chemicals from water and they have also been used to recycle wastewater for replacement of groundwater.[73]

Although optimistic evidence that a further reduction of water pollution is feasible can be found, there is also contrary evidence that many barriers oppose pollution reduction, even if the government was willing to undertake a stronger effort.

One problem is the lack of personnel for determining what pollutants should be regulated. Estimates of the number of chemicals in use range in

the tens of thousands. Yet, as John Cairns, director of the Center for Environmental Studies has stated:

> The number of people competent to carry out toxicity tests and environmental fate and effects determinations, however, is exceedingly small. Although people can be quickly trained (i.e. a year or two) for the crude short-term tests using lethality as an endpoint, it is extremely time-consuming to educate people to conduct the long term tests or interpret the data. Moreover, facilities suitable for carrying out such tests are not abundant. . . .[74]

Even if the government could decide which chemicals to focus on, it would be very difficult to find the culprits who are responsible for their discharge into the environment. There are thousands of firms that produce toxic substances. Some of them generate tiny amounts of lethal waste. Many toxic products are used in further production by a wide variety of companies other than the original producer. Together, these characteristics make evasion all to easy.[75] In addition, many producers and users of toxic substances are not even known to relevant government agencies. The small quantities of their wastes makes it difficult for outsiders to know what they are being expelled.[76] This compounds the difficulty faced by a government agency either to prevent pollution or to know where to go to clean it up once it has taken place.

Efforts to use technology to clean up already polluted water may also be unsuccessful. James J. Geraghty, an authority in the field of groundwater contamination, has flatly stated:

> Complete prevention of groundwater contamination is a physical and economic impossibility. The sources of contamination are so numerous and so diffuse that the economic considerations alone make this an infeasible objective.[77]

These sentiments were echoed by Cairns:

> The assumption that waste-treatment technology is capable of removing all alien (not there originally) materials from industrial process water, and that the discharge pipe could then be hooked up to the water intake pipe to produce a totally self contained system, has hindered criterion development. Even if such removal were technologically possible—which it is not in most cases—the energy requirements alone, not to mention the economic cost, would make it prohibitive.[78]

A final problem is finding people with sufficient skills to apply water pollution control techniques. Abel Wolman has contended that many places are greatly deficient in skilled personnel at all levels, particularly the smaller sewerage and wastewater treatment facilities. These systems, "which represent about 95% of all the systems in the U.S., do not have sufficient money or skill to provide either adequate or safe service."[79]

Some people have contended that rather than relying on government regulators to solve the problem of water pollution, support should be given to free-market incentives, one approach that will be discussed in the next section of this chapter.

Economic Systems for Pollution Control

One of the first proposals for a market-oriented solution to pollution was a system of effluent fees. Effluent fees charge polluters for each unit of pollution they emit. The logic behind such a system is that polluters are forced to bear the social cost of their emissions. Presently, if a company is not subject to any federal regulations for a pollutant (or it gets away with violations because the law is not enforced), it does not bear the burden of the "cost" of the dirty water it creates as it does bear the cost for the workers it hires, the materials it uses, and so forth. If the firm must pay a fee equal to the damage its pollution causes, then it is forced to compensate society for the harm it causes. This system encourages pollution control, as economics professor Wallace Oates has commented:

> A system of fees creates a direct incentive for polluters to reduce damaging waste emissions: effluent fees effectively harness the profit motive on behalf of the environment by making abatement pay. These incentives serve both to encourage current control activity and to stimulate research and development into new abatement technology.[80]

Professors William Baumol and Edwin Mills note that such a system would be easy to administer because the conventional polluting dischargers are reasonably easy to identify and the discharges are easy and inexpensive to identify.[81]

Another system, which has been used in Wisconsin, is the transferable discharge permit system. Under this system, there is an initial allocation of permissable discharges among the sources that is consistent with achieving clean water goals. Firms who discharge pollutants are then free to trade permits or buy them from one another. The end result is a system that controls pollution more efficiently than an across-the-board system of pollution controls. Companies who can reduce emissions cheaply will sell their permits to firms who would find it very expensive to cut pollution down. One study reported by Professor Oates estimates that "the Wisconsin system of variable and transferable permits can reduce total abatement costs by about 80% compared to a representative command and control regime that imposes an equiproportional cutback on all sources."[82]

Another system worthy of note is the German "deposit-refund" system. Under the German plan, people who import or produce lubricating oils pay a compensation fee that goes into a special fund. This money is

used to provide free disposal of the generator's waste oil. As disposal is free, the generator of waste has an economic incentive to deliver it to a disposal site where safe methods of disposal are ensured. This law encourages recycling or some form of safe disposal and thus reduces an important source of groundwater contamination.[83]

A pure subsidy system could also be instituted. This plan would make payments to those who bring their toxic wastes to some designated site. The subsidy would reverse incentives created by legal requirements to reduce pollution—rather than attempting to avoid or circumvent the law and pollute illegally, a producer can make money by turning in wastes at a location where they will be disposed of as safely as possible. Although some people would frown on such a system because it seems to pay people to pollute, Baumol and Mills have noted two major advantages to it:

- Waste producers are encouraged to identify themselves because that is the only way to gain a subsidy.
- There may be no effective alternative in the case of toxic substances.[84]

Free market solutions have potential risks. Under an effluent fee system, for example, it will not be easy to determine if the amount of the fee equals the social cost of the pollution. The system will not be economically efficient if the fees people are paying exceed the cost of their pollution. Yet tracing through all the costs of pollution such as illnesses caused, crops lost, lost recreational benefits, and so forth, would be extremely complex even if an agreement could be reached on values such as the worth of a human life saved.

Although such a system seems to keep decisions in the hands of private industry rather than government, federal regulators would have difficult choices to make just as they do when they impose the present regulations. Over time, inflation will reduce the real cost of pollution. New companies will increase the total amount of emissions. According to Professor Oates, the consequence is that

> Both of these forces will require the fee to be raised periodically if environmental standards are to be maintained. In short, the burden of initiating action under fees is on environmental officials; the choice will be between unpopular fee increases or nonattainment of standards.[85]

Thus if political pressures are impeding adequate enforcement of existing pollution control regulations, these same pressures could work to blunt the effectiveness of effluent fees.

Some people have moral problems with a system that imposes costs (which are borne by society in the form of higher prices and by workers in the form of possible layoffs) rather than imprisoning the high-level corpo-

rate officials whom they deem to be responsible for the pollution. The *Journal of Criminal Law and Criminology* noted:

> The Chicago School position may therefore show mercy to the corporate executive (who is saved from the possibility of incarceration by the recommendation of a corporate focus), but it imposes a harsh penalty on the less privileged classes (such as employees, consumers, and others dependent on the corporation) who bear the indirect burden of corporate penalties.[86]

A subsidy system would also risk problems beyond the ethical difficulties that may be caused by paying people to pollute. If subsidy levels are sufficiently great, they can make it profitable for a firm to manufacture inexpensive toxic substances just to be eligible for payments.[87]

The emissions permit system tried in Wisconsin has not been in existence long enough for a judgment to be made as to whether it should become national policy. Professor Oates notes that "it would be premature to describe them as the beginning of a broad movement toward pricing incentives for pollution control. It would be more accurate to regard them as two intriguing experiments with an innovative regulatory structure. Their future and their ultimate impacts on the development of environmental policy are, at this juncture, uncertain."[88]

One should also be careful in assuming that foreign legislation would have similar effectiveness in the United States. Commenting on the difficulties with adopting a system like Great Britain's (which relies heavily on government/industry cooperation) in the U.S., David Vogel has argued:

> Environmental regulation, like public policy in general, does not take place in a vacuum. Each nation's approach to regulating industry, like its policies for promoting industrial growth, is the product of distinctive political traditions and institutions.[89]

The first two case areas discussed in this section are general cases that could be applied to all pollutants. More specific case areas will be covered next.

Groundwater Protection

Many sources have noted with alarm that the nation's groundwater is rapidly becoming polluted with dangerous substances. Groundwater may be a particularly compelling area for government regulation because "there is no comprehensive groundwater federal law."[90] Although many acts including the Clean Water Act and Safe Drinking Water Act deal with groundwater to some extent, groundwater protection is not their primary focus. As a consequence, "the acts' different emphasis and implementing regulations have resulted in programs which overlap, duplicate and/or are incompatible with one another."[91] The lack of regula-

tion is troublesome because "often there are no surface water alternatives for communities that depend on groundwater. This makes the toxicity of chemicals found so far a particular cause for alarm. Most of the synthetic organics detected in drinking water wells are poisonous at high concentrations."[92]

Richard McHugh, executive director of the South Central Connecticut Regional Water Authority, recommended that landfills and water supply wells should not be located in the same aquifier recharge areas. In addition, the use of watershed inspectors to monitor land use activities in watersheds is advised. McHugh noted the following as particularly suspect activities that may need regulation:

- Use of pesticides in agricultural areas,
- Large manufacturing industries, and service industries such as dry cleaners, service stations, and garages, and
- Handling, storage, and disposal of chemicals at every level of use.[93]

If regulations fail to adequately protect groundwater quality, technology may have the solution. The *American Water Works Association Journal* indicated that "treatment processes can be put in place in a matter of days to remove harmful chemicals from water supplied by wells."[94]

Even if groundwater contamination is a serious problem, the solution is not necessarily a uniform federal program. According to the General Accounting Office (GAO):

> The diversity of sources, as well as regional and state differences, may make it impossible to identify a uniform nationwide solution to the problem of groundwater contamination.[95]

States are in fact beginning to take action. According to Jon Grand, "States are taking the lead in management and protection of groundwater, in the absence of a comprehensive federal program."[96] States including Connecticut, North Carolina, New York, and Wyoming, have aquifier classification systems that define and limit activities that can occur near various aquifiers. In addition, Wisconsin and Nebraska have groundwater protection standards.[97]

A technical solution to groundwater pollution may not be a viable option. *Newsweek* magazine classified the task of cleaning up an aquifier as being as "gargantuan as sweeping the Augean stables."[98] Toby Clark of the Conservation Foundation has said that the problem is "at best extremely expensive, and at worst irreversible."[99] Federal officials have put the cost of cleaning up just one typical ground water hot spot at $5 million.[100]

In addition to debate cases that remove pollutants that are not desired in the water, cases may also remove substances that are intentionally added to the water supply.

Limitations on Substances Intentionally Added to Water Supplies

Chlorine is added to the water supply in many cities for the purposes of killing bacteria and bleaching out brown coloring in some waters. It is argued that these desirable purposes are not the only effects of chlorine. Chlorine can combine with other chemicals to form toxic compounds, such as the known carcinogens trihalomethanes and chloroform. Dr. Robert Harris of the Council of Environmental Quality said that several studies which analyzed thousands of cancer deaths in Louisiana, North Carolina, Illinois, and Wisconsin, "add substantially to the evidence that there are measurable adverse effects from the chlorination of water; they should make believers of many of the scientists who have been disbelievers in the past."[101] An examination of gastrointestinal and urinary tract cancer mortality of chlorinated and nonchlorinated areas in seven New York counties found a statistically significant higher cancer mortality for chlorinated areas.[102]

A plan could require substitutes to be used instead of chlorine. Chloramines, which are formed when chlorine reacts with ammonia, are one alternative. One investigation demonstrated that chloramines can reduce trihalomethanes to less than ten parts per billion.[103] Granular activated carbon filters have also been suggested as an alternative. According to Jacqueline Warren of the Environmental Defense Fund:

> There is much evidence supporting the technology as available, reasonable in cost, and effective. Indeed, it has been widely and safely used in the beverage, food processing and sugar refining industries for decades. It is also currently used by 44 US communities for taste and odor control of drinking water with no evidence of adverse health effects or heavy metals contamination.[104]

Defenders of chlorination also exist. According to Foster Burba of the Louisville Water Company, the study of Massachusetts professors Tuthill and Moore is particularly significant because it used actual data rather than theoretical data. Their study concluded that "there is no evidence of statistical association between cancer and chlorination of drinking water."[105] Cities in West Germany have been chlorinating water supplies for more than a century, and a correlation between chlorination and cancer mortality has not been identified. It should be noted that Germany sets a maximum of 0.3 mg/liter for chlorine.[106] In comparison, the United States has chlorinated water supplies for fewer than eighty years and has no nationally established level of maximum chlorination.

Chlorine alternatives may not be adequate. Chlorine and eight other chemicals were considered for the disinfectant role by the National Academy of Sciences, but none of the other possibilities examined were considered adequate substitutes for the techniques presently used to disinfect drinking water.[107] Alternatives can also be expensive. The capital cost of switching to carbon for the Metropolitan Water District of

Southern California alone would be $181 million, with an additional $42 million in annual operating costs, according to water quality engineer Mike McGuire.[108]

Fluoridation is another process for which the potential costs and benefits have been debated. The intended purpose is the prevention of dental caries. Some authorities have claimed that fluoride does more than that, including damage to the kidneys, heart, arteries, and glandular and central nervous systems.[109] Fluoride has also been linked to cancer. According to Dr. Dean Burk, who had a thirty-five-year career in biochemistry at the National Institute of Cancer, 35,000 cancer deaths are caused each year in the U.S. due to fluoridation.[110]

Presently, about 60 percent of all Americans are drinking fluoridated water.[111] An affirmative plan could ban the fluoridation of water. Many Western European countries do not fluoridate, and after the Quebec ministry of the environment concluded that "fluorides are highly toxic for humans," the Canadian government suspended a compulsory fluoridation bill.[112] There is evidence that fluoridation is not even useful in fighting tooth decay. According to George Waldbott:

> In the ninth year of fluoridation in Newburgh, New York, school examinations disclosed a significantly greater need for dental work than in the nearby nonfluoridated control study of Kingston. In fluoridated Easton, Pa., dentist U.L. Monteleone found that the teeth of the economically deprived children were no better than those in nonfluoridated Allentown, Pa. In Illinois and Indiana, dental researchers showed there is little difference in dental practice and income between fluoridated and non-fluoridated communities . . . .[113]

Other sources take an opposite view of fluoridation. The GAO reported the endorsement of fluoridated water by many different organizations:

> Fluoridation has been endorsed as a safe, effective method of reducing tooth decay by numerous health organizations, including the American Medical Association, the World Health Organization, and the Public Health Service. The National Academy of Sciences also endorsed fluoridation as being safe and effective.[114]

The National Cancer Institute compared mortality in different geographic areas and found no difference in cancer rates between fluoridated and nonfluoridated areas when proper adjustments for age, sex, and race were made.[115]

Evidence of the health benefits of fluoride also exists. Based on epidemiological studies from the Midwest, H.T. Dean concluded that the prevalence of dental caries was negatively correlated within the fluoride concentration of drinking water.[116] One former U.S. surgeon general went so far as to call fluoridation one of the four most important public health measures in recent history.[117]

Most of the cases discussed thus far deal with threats to drinking water. Another approach is to deal with the quality of rainwater.

Acid Rain

Acid rain is caused by release of sulfur dioxide and nitrogen oxides into the environment. The major sources for these pollutants are electric utilities, which are responsible for 74 percent of the sulfur dioxide emissions in the thirty-one eastern states and 34 percent of the nitrogen oxides.[118] The problem is spreading nationwide. The National Wildlife Federation analyzed twenty-one states outside New England, and found highly acidic rain falling from Pennsylvania to Florida, as well as in California, Colorado, and Texas.[119] Acid rain has been related to a variety of environmental harms. According to a report by the Office of Science and Technology, acid rain not only endangers thousands of lakes and streams, but also it contributes to forest damage and may disrupt certain soil bacteria vital to the food chain.[120] Federal officials contend that the Clean Air Act is designed primarily to protect against localized damage, not the effects of pollutants that cross state boundaries, and legislative solutions are stalled in Congress.[121] An affirmative plan could create new legislation specifically geared toward reducing acid rain.

According to the National Academy of Science's report, "any reduction in acid rain pollutants would correspondingly reduce acid rain."[122] Two possibilities for the reduction of electric power plant emissions would be retrofitting power plants with scrubbers, which remove sulfur dioxide from exhaust gases, or requiring utilities to switch to low-sulfur coal.[122] A possible argument against acid rain control is the cost involved, but there is some evidence that the expense would not be substantial. A 1982 Office of Technology Assessment report stated:

> The measures adopted to achieve a 10 million ton sulfur dioxide emission reduction by 1995 throughout the 31 eastern states would increase electric rates 0 to 2% in Virginia and New York, for example, and 12 to 16% in Missouri and Indiana.[123]

Other sources deny the need for legislation to clean up utility emissions, either on the grounds that utilities are not the cause of acid rain or the claim that acid rain is not harmful. One suggested alternate cause of acid rain is natural conditions such as lightning, volcanoes, and the acidic forest floor.[124] Another hypothesis blames Smokey the Bear. Forest fires can destroy acid producing humus near a lake, which would neutralize a naturally acidic lake. The tremendous success in fighting forest fires has reduced the chances of this occurring. Increased acidity of lakes could be caused by the lack of forest fires rather than by acid raid.[125] In addition, most water in a lake does not come from direct rainfall. Much of the precipitation only ends up in a lake after going through a watershed. The

water passes through a series of filters during this process, and these natural filters could be the cause of acidity. William Brown of the Hudson Institute has suggested that

> At least one of these natural filters, the so called mor humus, can put far more acid into the rainwater than could any anticipated amount of industrial pollution. Indeed this humus may contain as much as 1,000 times the acid rain that falls from the sky in a year.[126]

The Electric Power Research Institute claims that acid rain is not harming crops extensively. Their research shows no significant effect of acid deposits on farmed soil, in great part because the soil is managed by the farmer who lays down lime and other buffers.[127] A recent study by the Council for Agricultural Science and Technology, a body of twenty-five food and agricultural science societies, reports similar findings.[128]

There are also potential disadvantages to placing more controls on utility emissions. According to Brown:

> It could eventually cost Americans about $100 billion in today's dollars to achieve a major reduction in sulfur dioxide emissions. Before committing to any program of this magnitude, we should want to be more certain that acid rain is in fact a major threat to the country's environment.[129]

Midwestern utilities claim that their rates would go up from 20 to 50 percent if they were required to reduce emissions by 50 percent.[130] If low-sulfur coal is switched for existing high-sulfur coal (mined currently in the Midwest) the United Mine Workers estimate that 800,000 coal mining jobs in the Midwest would be lost.[131]

General Disadvantages to Water Pollution Control Programs

There are several arguments that generally apply to increased federal regulation of water pollution. This section will discuss the disadvantages and possible arguments against them.

Cost Disadvantages

Expenses caused by a comprehensive national water quality plan could be substantial. The Environmental Protection Agency has estimated that there are almost $120 billion in unmet municipal wastewater treatment facility needs throughout the country.[132] The EPA further estimates that the total public money needed for water pollution abatement approaches $270 billion; for industry the total is $329 billion.[133] To provide the same treatment to nonpoint sources that is available to point sources would push costs even higher. Estimates range from $253 billion to $600 billion; these figures are in 1974 dollars and they would be even higher in current dollars.[134] Cleanup of toxic waste sites would also be costly. The current

Superfund is only sufficient to clean up about one-third of the 546 sites on the national priority list. Cleanup of 2,200 sites that are likely to be added to the priority list in the near future would lean to further expenditures of $8 to $16 billion.[135]

Any funding source employed to pay for such cleanup will have potential disadvantages. The federal government is one possible payer. If the government pays for the program through increased deficit spending, the nation's economy could suffer. According to the Council of Economic Advisers:

> The most important long-term economic effect of the prospective budget deficits would be to absorb a large fraction of domestic saving, and thereby reduce the rate of capital formation and slow the potential long-term growth of the economy. Federal borrowing to finance a budget deficit of 5% of GNP would absorb about two-thirds of all domestic saving that would otherwise be available to finance investment in plant and in equipment and in housing.[136]

The federal deficit has been cited as a reason that water quality programs should be transferred away from the federal government to local governments.[137] Office of Management and Budget director David Stockman analogized the government's fiscal condition to that of a corporation on the verge of filing for bankruptcy.[138]

A tax increase to finance a plan could have similar effects on the economy. According to a Treasury Department study reported in *Business Week:*

> Government spending crowds out the private sector regardless of whether the spending is covered by taxing or borrowing. Since the government borrows to finance predominantly activities that do not add to future productive capacity, nothing is gained by substituting higher taxes for borrowing. If anything, the depressing effects of higher taxes on economic growth would widen the deficit.[139]

Another way to finance a water quality plan would involve trading off increased expenditures on that plan with decreased expenditures for some other program. This trade-off could occur between water quality programs. According to James Tripp of the Environmental Defense Fund, "we have limited resources for both protecting and cleaning up groundwater."[140] An effort to emphasize one specific pollutant in the cleanup efforts could result in less funding being available to clean up other pollutants.

A comprehensive federal water quality plan could lead to trade-offs between that plan and other federal programs. The Reagan administration has shown an interest in curtailing social programs for the purpose of lowering the deficit. According to Senator Robert Dole, Congress would not spend more money unless it reassessed its priorities and determined where it might make offsetting savings.[141] When government spending

needs to be slashed, programs without a powerful constituency will be cut, even if their impact on human needs is significant. James Gogswell, director of the Office of World Service and Hunger wrote:

> Members of Congress feel pressure from their constituents to take care of needs close to home. They are pressured to deal with inflation, to solve the energy problem, to beef up military defense, and to cut back on all government spending for 'welfare,' whether at home or abroad. Many conservatives take this as a 'mandate' to reduce spending wherever possible on foreign aid.[142]

If the government requires industry and water districts to shoulder the burden of anti-pollution efforts, consumers will end up paying the price.

Elizabeth Lake, vice president of Urban Systems Research and Engineering, Inc., and her colleagues, professors William Hanneman and Sharon Oster, did a study of costs Americans will pay in response to the Clean Water Act. They identified different ways Americans will pay: through higher taxes, reduced public services, and increased prices. It should be noted that these cost figures represent expenses caused by existing laws. An affirmative plan would presumably go farther than the status quo and thus cost more money. Lake and her associates concluded:

- Public treatment works, based on the EPA's needs survey would lead to a tax increase of $133 in 1985 for the average family.
- The average family will pay $476 in 1985 in the form of higher prices charged by industries which have had to spend more money on pollution control.
- The total burden of pollution control laws constitutes ten times the burden on the lowest income groups as it does on the highest income groups, averaging about 4 percent of a low-income family's total income.[143]

Consequently, it is not surprising that a survey of households in Clifton Springs, New York, found that twice as many respondents with an income above $30,000 were willing to pay a significant rate increase for good quality water than were families with an income of less than $15,000.[144]

Arguments Against Cost Disadvantages

Not all sources agree that water pollution control is prohibitively expensive. According to Lewis Regenstein:

> Opponents of laws and regulations to clean up and prevent water pollution often cite the tremendous costs involved in environmental protection. However, recent studies show that it is pollution that is costly, and that cleaning it up saves billions of dollars. One study commissioned by the President's Council on Environmental Quality and released in April 1980, estimates that the removal of conventional water pollutants would, in 1983, "yield water pollution control benefits of about $6.5 to almost $25 billion per year . . . ."[145]

Economics professor A. Myrick Freeman III suggests that these estimates could understate considerably the true water pollution control benefits to be enjoyed in 1985 since they do not include preventing damage by toxic pollutants to shellfish beds and commercial fisheries and prevention of the adverse health effects of organic chemical and heavy metal contamination in drinking water.[146] The Council on Environmental Quality says that "total benefits could grow dramatically once the benefits from reducing these pollutants are included."[147]

Even if pollution control is costly, the consequences of higher expenditures are not necessarily disastrous. Evidence exists that a high deficit does not harm the economy. According to Gerald Dwyer of Emory University:

- Predictable changes in government debt do not affect any other variable in the economy.
- No support was found for the hypotheses that a deficit increases prices, thus expected government deficits have no significance for future inflation.[148]

Nor will increased federal spending on pollution control necessarily lead to cuts in social programs. Professors Fred Doolittle and Richard Nathan of Princeton University have noted that the president has been significantly less successful in cutting domestic and social spending in each succeeding year.[149] Congress also has been said to have reached a "legislative hard core" of the budget, at which point they do not wish to make further cuts.[150]

If the costs of pollution control are to be borne by the general public, it need not follow that the public would be opposed. According to Congressman Dennis Eckart, "People in this country are aware of these necessities (air, food, and water) and have chosen to spend over $1 billion per year on bottled water and home filtering devices to increase the quality of their drinking water."[151] Although Lake, Hanneman, and Oster noted significantly higher costs to the public because of water quality standards, they also opined that the total cost to the average family is small relative to total family income (2.43 percent). Even for the poor, Lake, Hanneman, and Oster suggested that their burden (4 percent of the income on the average) was not disproportionate because it is roughly comparable to their federal income tax burden.[152]

Employment Effects of Water Pollution Control

A popular argument against pollution control is that it leads to unemployment. One contention is that environmental regulations force businesses to spend money on pollution control, rather than making investments that improve productivity or expand their facilities. The latter investments are said to create more jobs than pollution control,

which may not add anything productive to the economy. A study by Arthur D. Little, Inc. analyzing the performance of the U.S. steel industry in meeting the Clean Air Act and Federal Water Pollution Control Act concluded:

- Meeting projected environmental requirements would increase the steel industry's capital shortfall by $1.3 billion per year from 1985 to 1989.
- By 1989, as marginal facilities are forced to shut down by lack of capital availability or profitability, steel industry shipments could decline by 8 to 20 million tons per year.
- Steel industry job losses due to environmental requirements could range from 25,000 to 57,000.[153]

A second potential cause of unemployment is that some firms could be forced to close because it is technologically impossible to meet pollution control requirements. For example, two pulp mills in Alaska, which employ 1,100 people and are vital to their rural economies, are threatened with closure even though they have installed secondary treatment and meet stringent state water quality standards. If peculiar land, energy, and logistic constraints are not taken into account, particular communities could be devastated by across-the-board pollution requirements.[154]

To counter the unemployment argument, it has been contended that pollution control costs are only a small fraction of the total capital costs (6.2 percent for the chemical industry and 8.5 percent for petroleum, for example). Therefore, even if environmental controls were eliminated completely, the savings would not greatly influence total capital availability.[155] In addition, the National Wildlife Federation has noted that "while corporations have blamed pollution requirements for decisions to close 155 plants at a loss of 33,000 jobs since 1971, the nation's air and water cleanup laws will have stimulated some 524,000 new jobs by 1987."[156]

Business Confidence

The business confidence argument postulates that investor confidence in the government's ability to maintain a climate favorable to business is important to encouraging investment. It may be maintained by the negative team that the Reagan administration has worked very hard to stimulate this favorable climate by getting the government off industry's back. A sudden inversion of this policy, such as imposition of hundreds of billions of dollars of new pollution control requirements, could be claimed to reverse this favorable environment and discourage investment, both in the industries directly affected and in other industries who fear they could be next. However, this argument is not universally ac-

cepted. According to one Washington lawyer, "Most of industry is pretty well fed up with the way this administration approaches environmental issues. There's been a broad across-the-board acceptance of environmental regulations as a fact of life."[157]

CONCLUSION

Many diverse sources of water pollution have been identified and studies have shown a possible, if not certain, link between water pollution and human health. There are many laws on the books that could be used to further limit pollution, although the current administration has not made their implementation a major priority. A major issue to be debated is whether this de-emphasis on protection of the environment is caused by corporate co-option of the regulatory process, or in fact motivated by a genuine threat to an economy that cannot afford to spend hundreds of billions of dollars on problems not conclusively proven to exist.

4. Water Scarcity Issues

Resolved: That the federal government should implement a national system of priorities to control the allocation of all water in the United States.

Overview

Water is a renewable resource. However, despite once plentiful supplies, there is concern that the United States may be depleting this resource through a combination of increased demand, reduced supply of clean water, and inefficient or wasteful use. Dr. Thomas Hellman comments on the increased demand for water:

> There has been an approximate 200 percent increase in this nation's population in the past 80 years, but the consumption of water on a per capita basis has increased 500–800 percent. This is about 2,000 gallons of water used per day for each man, woman and child in the U.S., and three times the per capita water use by the Japanese.[1]

Most of the demand for water is from agriculture, which uses over 83 percent of the total consumed. Industry uses about 7 percent, domestic households use 6 percent, and electric utilities use 3 percent. Table 2 shows the water withdrawals and consumption per day in each state while Figure 3 graphically illustrates the total U.S. water withdrawals since 1940.

There is growing concern that the supply of water is also being restricted. The Trend Analysis Program considered both surface and groundwater in its forecast:

> The U.S. Water Resources Council projects that there will be inadequate surface water supply by the year 2000 in 17 of the 106 U.S. water resource subregions, mostly in the Midwest and Southwest. Conflicts will grow between domestic, industrial, and agricultural uses and fish habitation, recreation, and hydroelectric uses.
>
> In the case of ground water, the availability problem centers on overdrafts—withdrawal of water faster than it can be recharged. Groundwater overdraft is occurring in the High Plains, in south-central Arizona, and in parts of California. Of every 100 gallons of water removed, only 74 are replaced. As depletion progresses, groundwater levels decline, spring and stream flows diminish, fissures form, land subsides, and in some cases salt water finds its way into the freshwater aquifiers.[2]

Table 2

NO. 350. WATER WITHDRAWALS AND CONSUMPTION PER DAY—STATES AND PUERTO RICO: 1980

[Figures may not add due to rounding. Withdrawal signifies water physically withdrawn from a source. Includes fresh and saline water; excludes water used for hydroelectric power)

STATE	WATER WITHDRAWN					*Fresh water consumed*[2] *(mil. gal.)*
	Per capita[1] *(gal.)*	*Total (bil. gal.)*	*Surface (bil. gal.)*	*Public supplies (bil. gal.)*	*Irrigation (bil. gal.)*	
Total	1,953	450.0	360.0	34.0	150.0	100,000
Ala.	2,824	11.0	10.0	.6	(Z)	570
Alaska	546	.2	.2	.1	—	35
Ariz.	2,929	8.0	3.7	.6	7.1	4,500
Ark.	6,960	16.0	12.0	.3	5.1	3,600
Calif.	2,272	54.0	33.0	4.1	37.0	25,000
Colo.	5,512	16.0	13.0	.6	14.0	4,000
Conn.	1,188	3.7	3.6	.4	(Z)	160
Del.	2,013	1.2	1.1	.1	(Z)	11
D.C.	534	.3	.3	.2	—	23
Fla.	2,127	21.0	17.0	1.4	3.0	2,400
Ga.	1,259	6.9	5.7	.8	.6	1,000
Hawaii	2,548	2.5	1.7	.2	.9	680
Idaho	19,007	18.0	12.0	.2	16.0	5,900
Ill.	1,574	18.0	17.0	1.8	.1	590
Ind.	2,551	14.0	13.0	.6	.2	690
Iowa	1,476	4.3	3.5	.3	.1	290
Kans.	2,788	5.6	1.0	.3	5.6	4,700
Ky.	1,311	4.8	4.6	.4	(Z)	290
La.	3,079	13.0	11.0	.6	2.2	3,500
Maine	1,421	1.6	1.5	.1	(Z)	53
Md.	1,622	7.7	7.8	.5	(Z)	100
Mass.	1,027	5.9	5.6	.8	(Z)	90
Mich.	1,621	15.0	14.0	1.3	.2	460
Minn.	759	3.1	2.4	.4	.2	450
Miss.	1,387	3.5	2.0	.3	1.0	710

(continued)

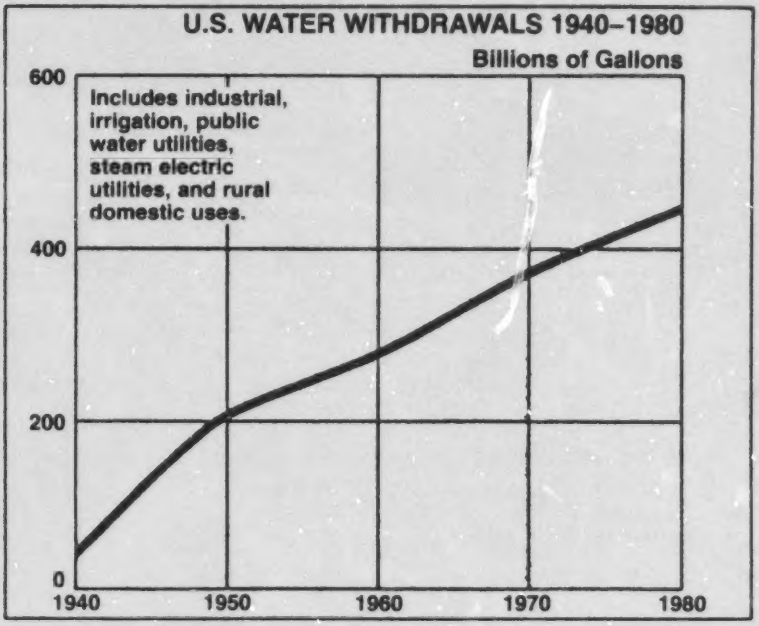
Table 2 (Continued)

[Figures may not add due to rounding. Withdrawal signifies water physically withdrawn from a source. Includes fresh and saline water; excludes water used for hydroelectric power)

STATE	WATER WITHDRAWN					Fresh water consumed[2] (mil. gal.)	STATE OR OTHER AREA	WATER WITHDRAWN					Fresh water consumed[2] (mil. gal.)
	Per capita[1] (gal.)	Total (bil. gal.)	Surface (bil. gal.)	Public supplies (bil. gal.)	Irrigation (bil. gal.)			Per capita[1] (gal.)	Total (bil. gal.)	Surface (bil. gal.)	Public supplies (bil. gal.)	Irrigation (bil. gal.)	
Mo.	1,401	6.9	6.4	.7	.1	670	Pa.	1,347	16.0	15.0	1.5	.2	920
Mont.	13,959	11.0	11.0	.1	11.0	2,700	R.I.	527	.5	.5	.1	(Z)	15
Nebr.	7,634	12.0	4.9	.3	9.	7,600	S.C.	1,983	6.2	6.0	.4	.1	280
Nev.	4,461	3.6	2.9	.2	3.1	1,700	S. Dak.	1,000	.7	.4	.1	.5	460
N.H.	1,083	1.0	.9	.1	(Z)	17	Tenn.	2,176	10.0	9.6	.5	(Z)	270
N.J.	1,356	10.0	9.6	1.1	.1	380	Tex.	1,466	21.0	13.0	3.8	8.4	10,000
N. Mex.	2,989	3.9	2.1	.2	3.6	1,900	Utah	3,125	4.6	3.6	.8	3.2	2,900
N.Y.	967	17.0	16.0	2.2	(Z)	590	Vt.	664	.3	.3	(Z)	(Z)	41
N.C.	1,376	8.1	7.3	.6	.1	760	Va.	1,809	9.7	9.3	.6	(Z)	230
N. Dak.	1,988	1.3	1.2	.1	.3	330	Wash.	2,001	8.3	7.5	.8	6.4	2,900
Ohio	1,296	14.0	13.0	1.4	(Z)	550	W. Va.	2,872	5.6	5.4	.2	(Z)	200
Okla.	592	1.8	.8	.3	.9	1,000	Wis.	1,227	5.8	5.2	.6	.1	310
Oreg.	2,578	6.8	5.7	.2	5.9	3,200	Wyo.	11,368	5.4	4.8	.1	4.9	2,600
							P. Rico[3]	960	3.2	2.9	.4	.3	300

— Represents zero. Z Less than 50 million. [1]Based on population as of July 1. [2]Evaporated, transpired, or incorporated into products; excludes irrigation conveyance losses by evapotranspiration. [3]Includes Virgin Islands.
Source: U.S. Geological Survey, *Estimated use of Water in the United States in 1980*, Circular 1001.

From: *Statistical Abstract of the United States.*



SOURCE: Statistical Abstract of the United States, 1982–1983.

Figure 3. From: *The Futurist*, April 1984.

Water resources were once thought to be inexhaustable. If supply ran low, the answer was to pipe water in from surrounding areas. If water was polluted, dump it downstream or, in later years, treat it and then dump it. Since water was cheap, wasteful and inefficient use of this resource was encouraged.

The shortage of water could be the "energy crisis" of this decade. Any decision that establishes priority allocation of this resource will reflect certain values and interests. Dr. Baumann, a geographer from Southern Illinois University, explains that "to some, a resource is the physical substance itself; to others, it is its market value; and yet to others, its beauty."[3] For example, a decision to create a reservoir of surface water by damming a river may destroy existing wildlife habitats and recreational uses of the river. At the same time, it creates a new home for some species of wildlife and opens new recreational opportunities while providing water for farmers, electrical generation, and home use. Similarly, an allocation system that places the highest priority on drinking water devalues other possible uses of that resource.

This chapter will cite efforts to increase the supply of water, specifically increased use of groundwater and the creation of new federal water projects. The demand for water will be explored by examining case studies of resource use in irrigation and for Indians on reservations. Finally, the options for conserving or securing water will be explained. The material covered in Chapter 3 is especially important to review as the issues of water scarcity are discussed. Pollution of existing waters is a major factor in the need to secure additional sources of this resource. In a like manner, the topic of scarcity lends importance to the urgency to clean up environmentally degraded water. Thus, all three debate resolutions are interrelated.

Groundwater

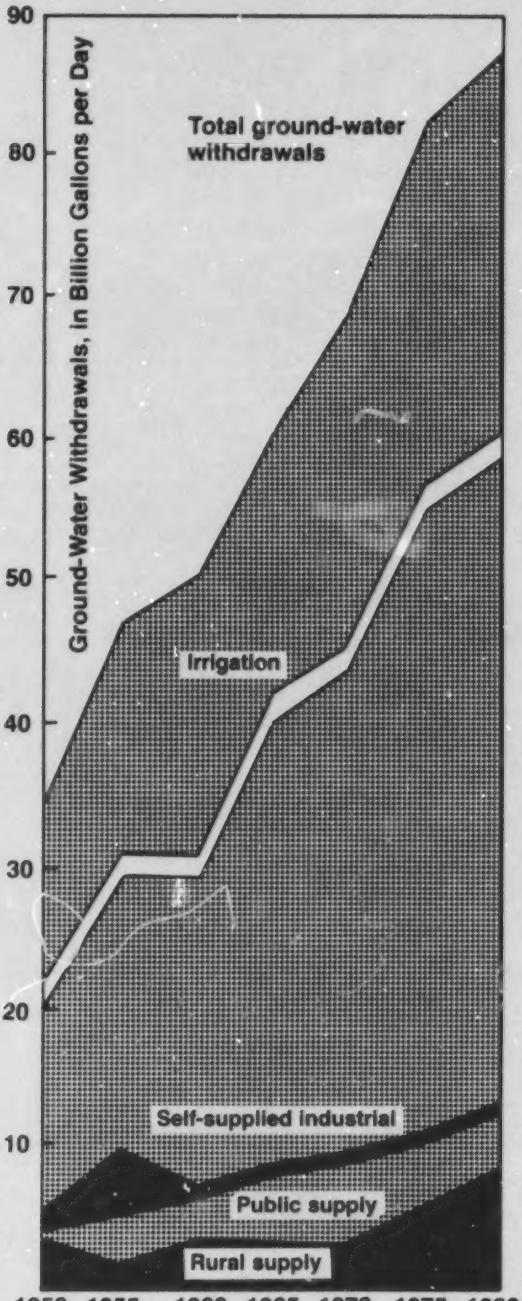
The most abundant source of untapped water in the United States is underground. Development of new, fresh supplies of water will depend on the nation's ability to extract groundwater since the best reservoir sites and surface rivers have already been utilized. Philip Cohen, chief hydrologist for the U.S. Geological Survey, notes:

> Ground-water withdrawals in 1985 probably will amount to about 95 billion gallons a day, continuing to be about one-fifth of the total freshwater usage in the nation. To meet rising demand, well fields will be enlarged, new well fields constructed, and the number of individual wells increased to supply single homes and other small uses.[4]

Figure 4 illustrates the increasing use of groundwater since 1950. Increased demand for groundwater will be spurred by:

- Rapid expansion of sunbelt cities with inadequate supplies of surface water.
- The need to utilize water supplies capable of weathering long period of drought. Although the groundwater resource is not immune to drought, its sheltered environment and the large volumes of groundwater in storage lend the resource to supplementary water service during times when streamflow and surface storage are deficient.
- Increased use of irrigation in all areas of the country.
- Consumption of large quantities of water by new energyproducing industries ranging from power generation to coal mining to coal sluices.
- The decreasing availability of surface water in many areas of the nation.[5]

This increased use of groundwater is cause for concern. The Trend Analysis Program noted earlier in this chapter that more groundwater is being removed than is being replaced. Some major sources are being rapidly depleted. "The major groundwater depletion problem is in the



Trends in ground-water withdrawals in the U.S., 1950–1980.

Figure 4. From: *The Futurist,* April 1984.

High Plains region, which overlies the huge Ogallala Aquifier extending from west Texas to northern Nebraska. Other areas showing pronounced effects of groundwater overdrafts are the San Joaquin Valley, Houston, Southern California, and Savannah, Georgia."[6]

There are unavoidable natural consequences of increased extraction. "From a hydraulic point of view," comments Geologist Cohen, "pumpage from an aquifier or groundwater basis must result in lowering groundwater levels."[7] Among the consequences of lower water levels are:

- Lowered water levels increase the cost of drilling, increase the power consumed in extraction, and reduce well yields.
- Surface waters or ocean water may be induced to flow into groundwater systems thus contaminating the water supply.
- Land sinks or surface subsidies occur as water is extracted. This has been identified in ten states and results in permanent loss of subsurface water tables; structural damage to buildings, roads, bridges; inundated coastal areas; and changes in the grade of canals and irrigated slopes.

Problems associated with pumping waters are compounded when portions of this country's groundwater reserve are polluted.

Pollution: Sources

Any element or process that causes pollution of surface waters also pollutes groundwater. Among the leading sources of contamination according to geologist David Miller are:

- stored industrial wastes
- landfills
- septic tanks and cesspools
- municipal wastewater
- mine spoil piles and tailings
- gasoline storage tanks
- waste disposal wells
- accidental spills and leakage.[8]

Figure 5 shows the process of how such pollution reaches underground reservoirs of waters.

The scope of this problem is outlined by the U.S. Water Council's roster of groundwater problems which claims that "every region of the country experiences groundwater pollution problems, both point and nonpoint."[9] Pollution of America's groundwater is becoming a particularly strong concern. Although groundwater has traditionally been assumed to be pristine, it is now known to contain high concentrations of organic chemicals, "which are often orders of magnitude higher than those found in raw

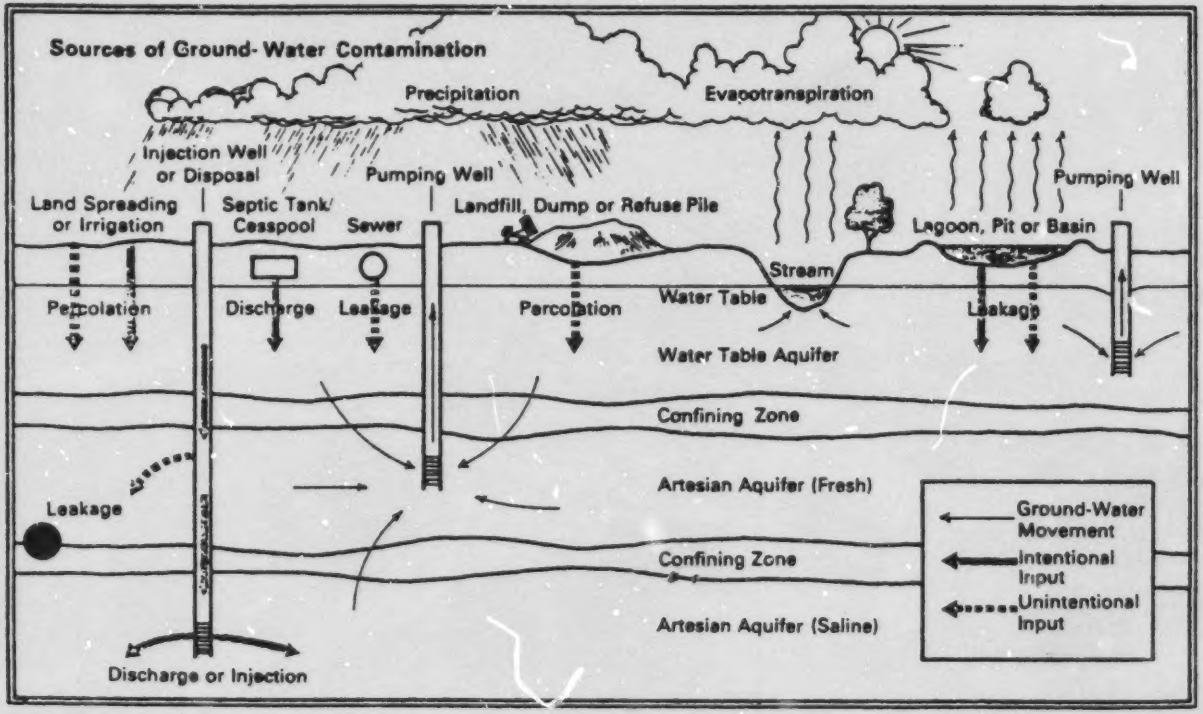


Figure 5. From: *EPA Journal*, July/August 1984.

or treated drinking water drawn from the most contaminated surface supplies, such as the Kanawha River in West Virginia."[10]

One of the biggest contributors to water pollution is industrial waste. Much of this waste is stored in surface water impoundments, such as pits, ponds, or lagoons. According to the Environmental Protection Agency, 50 billion gallons of new wastes are added to such impoundments daily. The EPA has identified 25,749 industrial impoundments, of which 72 percent are unlined, and only 699 are known to be monitored.[11] Unlined impoundments can leak a wide variety of toxic chemicals into underground water supplies. Ninety-five percent of all operating surface impoundments are located within one-fourth mile of drinking water supplies.[12]

Another problem is the wastes disposed of in landfills. According to the Office of Technology Assessment (OTA), the limitations of land disposal technology are "likely to cause serious problems for future generations."[13] The OTA notes that 526 of the 881 sites that have been listed as a priority for cleanup under the Superfund program are there because of actual or possible contamination of groundwater. Millions of Americans are potentially at risk from exposure to this contaminated groundwater. Overall, the EPA has estimated that three-fourths of the active and abandoned chemical waste dumps are leaking.[14]

An increasing amount of contamination comes from illegal dumps, operated by criminals. Such unscrupulous operators are only concerned with making profits and pay no attention to safe disposal practices.

Gasoline is another major culprit. EPA Assistant Administrator Jack Ravan has identified gasoline as one of the most common causes of groundwater pollution in many parts of the country due to leakage from underground storage tanks, with 11 million gallons of gasoline released into the ground each year.[15] According to Ravan, this is particularly troubling because "one gallon of gasoline per day leaking into a ground water source is enough to pollute the water of a 50,000 person community to a level of 100 parts per billion."[16]

Impoundments, landfills, and gasoline are not the only problems. The Office of Technology Assessment has identified thirty-six different sources of contamination. Other serious pollution sources they mention include agricultural fertilizers, oil and gas wells, and subsurface percolation from septic tanks and cess pools. Underground storage tanks are especially troublesome. These steel tanks rust and corrode over time,and thousands of such tanks are now leaking toxic chemicals into drinking water supplies nationwide.[17] The Council on Environmental Quality has also listed mining wastes, storm sewers, and air pollution as "troublesome contributors to the degradation of water quality."[18]

Pollution: Harms

The harms of water pollution were discussed at great length in Chapter 3 and will not be repeated here. Despite the data presented in the last section, there is not universal agreement that groundwater pollution has reached crisis proportions in America. James Geraghty, who manages groundwater contamination field exploration programs, has argued:

> Groundwater experts believe that much less than 1% of the nation's fresh groundwater reserves has been contaminated and that the rate of movement of plumes is so slow that only a relatively small segment of the population is currently being threatened. Deep aquifiers, in particular, are still essentially immune to contamination that is present in shallow geologic units, and in many localities it could take from decades to centuries before the deep aquifer systems become degraded as a result of man's activities.[19]

According to the EPA, "Only 15 percent of the nation's drinking water supplied from groundwater sources has been touched by the slightest chemical contamination."[20] Any existing water pollution is not likely to spread fast. Water from a contaminated well only moves between a fraction of an inch and a few feet per day, thus there is very little mixing of groundwater.[21]

While there is only a small percentage of polluted groundwater, this contamination is particularly difficult to clean up. William Ruckelshaus, former EPA administrator, notes:

> Specific problems associated with ground-water contamination are among the most complex that EPA has ever had to deal with. Ground-water contamination is extremely difficult to detect and monitor, and it is not readily amendable to conventional cleanup measures. At present, we simply do not know how to clean up most ground-water pollution.[22]

Unlike the water in polluted rivers, lakes, and streams, groundwater is never exposed to the sunlight and air that help to cleanse surface water. Chemicals also hide in the soil and do not wash into the aquifer until it rains. Thus, Robert Harris of Princeton University has concluded that "once you contaminate groundwater, you may contaminate it for geologic time."[23]

Groundwater Regulation

Now is the time to regulate both the allocation and the quality of groundwater before the resource is depleted or poisoned. Dr. Thomas Hellman concludes:

> We are fortunate that the supplies of ground-water in this country are vast. If we act now to apply our knowledge and skills in protecting this resource, we can assure the development of a sound ground-water

> management system resulting in a supply of water for all uses. Comprehensive ground-water management is necessary to protect public health and the environment while responsibly maintaining multiple uses of the resource. This type of an approach is needed to insure that we do not misuse our ground-water resource.[24]

Hellman sees the need for a comprehensive federal, state, and local groundwater management plan.

The federal agency that has become the focus for developing a response to groundwater issues is the EPA. Unfortunately, according to Jon Grand of the Council of State Governments, "The federal groundwater programs are now fragmented between a number of different program areas including water quality, drinking water and hazardous waste. The inconsistencies are repeated as state programs attempt to mirror the requirements of the various federal program areas."[25]

An EPA Groundwater Task Force reported its initial findings in January 1984. Alvin Alm, deputy administrator of the EPA, reported its findings:

> After extensive analysis of EPA statutory authorities as well as existing state ground-water programs, the Task Force concluded that the nature and variability of ground water makes its management the primary responsibility of the states. However, a number of significant federal authorities exist to support states in the effort. The group also found that since these federal laws were enacted at various times for separate purposes, some inconsistencies in regulations and decisions made under them have hindered a cohesive approach to ground-water protection. In addition to EPA's authorities, the Task Force found a variety of state and local authorities that can be used to protect ground water. Many states have already begun programs in this area, and fostering the continued development of state capability to protect ground water was deemed vital.[26]

This emphasis on placing primary reliance on the states is seconded by Governor Bruce Babbitt of Arizona.

> The nature of the ground-water resource and the large variations in emphasis and structure among existing state ground-water programs tend to argue against the promulgation of a national ground-water program. States, with their inherent responsibility for water allocation and protection activities, jealously guard the right to control this resource. But admittedly the pattern of state activities is uneven. Citizens of two different locales should not suffer as a result of different levels of health protection.[27]

Solutions to the problems of groundwater quality and use are just emerging. Both the technology and the regulatory framework must advance to meet future needs.

Water Projects

The federal government is a prime sponsor of surface water projects in the United States. "Water project" encompasses a wide range of activities

including building dams, flood control efforts, dredging rivers or ports, widening channels, and developing irrigation projects. The major federal agencies involved in these efforts are the Army Corps of Engineers and the U.S. Bureau of Reclamation, which operates primarily in the West.

Both the Carter and Reagan Administrations have fought hard to control the costs of proliferating water projects. Congress has set forward several bills that have been vetoed. There has been no omnibus water project bill since 1976. This does not mean that no projects have been funded. Several smaller appropriations have been approved. The Reagan Administration opposes not only the high cost of projects but also the 100 percent federal funding of costs. This issue is highlighted by Katherine Barton:

> But in addition to size, the debate will focus on how much of the costs of the projects local beneficiaries should pay. The Reagan administration and environmentalists are aligned in pressing for local users to pay a larger portion of the costs. The administration wants to get the federal government out of the water project business; environmental groups believe that if local beneficiaries have to shoulder more of the costs, they will give more careful scrutiny to their needs and will build fewer environmentally damaging projects.[28]

Reagan originally requested that states or localities match 30 percent of the costs. What has emerged is a more flexible, case-by-case review, seemingly based on ability to pay. This new policy was applied in the 1985–86 budget request for the Corps of Engineers:

> Of the 29 new construction projects proposed in the corps budget—five of which are in California—all but one have "some sort of pre-arranged agreement on cost sharing," said Corps spokesman Ed Green.
>
> Green said that, as far as he knew, this represents the first year that the administration has selected projects based on the agreement of local beneficiaries to contribute a certain portion of the money needed for the project.[29]

Congress is concerned that this policy would mean that wealthy areas would get all the water they need, while poorer areas would suffer.

While the debate on cost sharing continues, several water bills were passed in 1984. The *Congressional Quarterly Weekly* notes:

> The largest water measure cleared was the fiscal 1985 energy and water appropriations bill (HY 5653—PL 98-360), which gave $3.8 billion to the U.S. Army Corps of Engineers and the Interior Department's Bureau of Reclamation.
>
> This funding was mostly for projects that are already authorized and under construction, or for operation of projects already built. Once construction starts, projects are hard to kill.
>
> Annual appropriations for the corps and the bureau, together with the smaller Soil Conservation Service, have proven pretty reliable over the years—flowing more steadily than rivers themselves, which are prone to drought and flood.[30]

Another bill authorized $650 million to improve the safety of Western dams. Yet a third bill called for study and demonstration projects exploring the potential for groundwater recharge in the high plains states above the Ogallala Aquifer.

> The bill (S. 71—PL 98-434), authorizes $500,000 for a study of the problem, and another $20 million to demonstrate technologies (such as high-pressure injection of water from surface sources) for recharging the aquifers.
>
> That $20 million, however, must be matched by some $5 million in local funds, a 20 percent cost-sharing figure that disarmed objections from potential critics.[31]

A fourth bill, enacted over President Reagan's veto, authorized $36 million for water resource research. This law continued funding of federal matching grants for water resource institutes, water resource projects, development of new technology, and conveyed land for desalinization demonstration projects.[32]

The prospects of major new federal efforts to secure new sources of surface water for irrigation, power generation, or domestic consumption seem bleak. This means the states must shoulder the burden for new water projects. The likely result will be a reduction of new construction efforts and a reduced ability to tap additional surface water.

Irrigation

Over 80 percent of the water consumed in the United States is used for agriculture and over 80 percent of agricultural water is for irrigation. Federal government water projects have created vast tracts of irrigated land in the western states. Low-cost water has turned semiarid areas into productive orchid or crop lands. Irrigation is now being adopted in other areas of the country as new technology allows for extraction of groundwater. Hydrologist Philip Cohen provides several examples:

> In Nebraska, irrigation pumpage amounted to 6.7 billion gallons a day in 1980. The development of center pivot-equipment, whereby a moving sprinkler pipe rotates around a central supply well to irrigate a large circular area, has led to a manifold increase in irrigated acreage and enlarged dependence on ground water as a source of irrigation supply. With the aid of center-pivot irrigation and other newly developed equipment, irrigation usage of ground water in Georgia rose 1,000 percent between 1975 and 1980.[33]

Chemicals have also been used in fertilizers, pesticides,and herbicides to bring profitable farming to marginal land. This combination of water and chemicals has been a mixed blessing as explained by Lindsey McWilliams: "While water and agricultural chemicals have helped to set new crop production standards, they sometimes have combined to pollute groundwater and endanger the health of people, livestock, and other animals."[34]

Chemicals

There are almost 600 active chemical ingredients used in approximately 35,000 registered pesticides that seek to control 2,500 different species of pests. Farmers account for 60 percent of the $7 billion spent on pesticides each year. Since the 1960s, total pesticide use in the United States has doubled. Agricultural use has nearly tripled in the past twenty years. The *EPA Journal* reports a leveling of this trend:

> During the last few years, the growth rate for agricultural pesticide use has slowed somewhat due to economic conditions and the influence of improved pest management programs which resulted in more efficient application of pesticides and the use of alternative non-chemical pest controls. The year 1982 was the first in recent times when total U.S. agricultural pesticide use declined.[35]

One of the major problems in the use of pesticides is the contaminated water that drains from irrigated fields. An example of this process is found in the Central Sands region of Wisconsin. Irrigation has made it possible to cultivate land that otherwise could not support profitable farming. Unfortunately, University of Wisconsin researchers have discovered that growers overirrigate: "Lacking the means to monitor soil moisture and the anticipated demands of his crop, the farmer must, as a management decision, overirrigate. The economic consequences of insufficient moisture far outweigh the cost of extra water."[36] The consequence of this inefficient use of water is explained by Lindsey McWilliams:

> Excessive water drives nutrients and chemicals down from the root zone, denying crops the nourishment and protection they need. The results are increased costs for chemicals and irrigation, and lower yields. Once contaminated, groundwater is slow to cleanse itself, so any pollutants in it could be a threat to human and other animal safety for many years. In central Wisconsin, the two pollutants attracting public and government attention have been aldicarb and nitrates—two soluble and valuable agricultural chemicals.[37]

Natural Contaminates

Dissolved salts and minerals also create a pollution problem. Ancient civilizations along the Nile, Tigris, and Euphrates rivers lost valuable farmland because inadequate drainage built up salts in the soil resulting in unusable land. A similar phenomenon occurs in the contamination of the Colorado River.

> Dissolved salts and minerals are a major pollution problem for the Colorado River, and the United States has a treaty obligation to Mexico, where the river ends, to keep salinity at certain levels. Irrigated agriculture is both a cause and a victim of salinity in the Colorado and its tributaries. Too much irrigation washes salts from the soil and causes downstream farmers trouble when the salt levels exceed what their crops will tolerate.[38]

The most recent example of problems caused by poor drainage of irrigated fields involved the Kesterson Wildlife Refuge in Central California. Water from 42,000 acres of farmland was found to contain toxic levels of selenium, a naturally occurring mineral. Irrigation water leached the selenium out of the soil and was stored at Kesterson. A brief overview is provided in an article from *The Sacramento Bee:*

> Irrigated agriculture, a benevolent giant that brought prosperity and inexpensive food to millions, is suddenly being seen by some as having grown like Frankenstein's monster into a perverted, destructive force.
>
> The potentially monstrous problem contronting farmers and society at large is what to do with irrigation water after it has left farm fields and become drain water, often contaminated with pesticides and other chemicals.
>
> The answer for growers in the west San Joaquin Valley had been to send it to the Kesterson National Wildlife Refuge, an out-of-the-way spot south and east of San Francisco that migrating birds on the Pacific Flyway from Canada to Mexico use as a stopover.
>
> But dumping drain water into the 5,900-acre refuge was questioned as much as a decade ago by scientists who said the refuge would be polluted and deadly to the wildlife that used it.
>
> Then, just last week, citing concern over the Migratory Bird Treaty Act that protects water fowl, the Department of Interior ordered the drainage system into Kesterson shut down.[39]

There has been a steady buildup of contaminates throughout the San Joaquin Valley. The physical process of contamination requires a set of special geophysical factors:

> In other areas where selenium is believed to exist in native soils, no known damage has resulted. Generally, that occurs in areas—including the Sacramento Valley--where heavy rainfall washes it out of the soil and out of the region into the ultimate salt sink, the ocean.
>
> But where there is the combination of selenium, an arid climate—less than 10 inches of rainfall a year—and intensive irrigation of poorly drained, desert-like soils, problems like those at Kesterson can be expected to occur, said Barnes. Barnes said new USGS [U.S. Geological Survey] research shows such selenium-bearing, pyritic deposits in the 10 Western states.
>
> The Bureau of Reclamation—which built the massive Central Valley Project that unlocked the selenium genie in California—has major irrigation projects in each state.[40]

A graphic illustration is provided in Figure 6.

The cost of cleanup of drainage wastes has been estimated at over $13 billion just for the San Joaquin Valley of California. It has been estimated that taking the 42,000 acres that use the Kesterson Refuge for drainage out of production will result in a loss of $100 million to farmers and the local economy.[41] The true magnitude of this problem is yet to be deter-

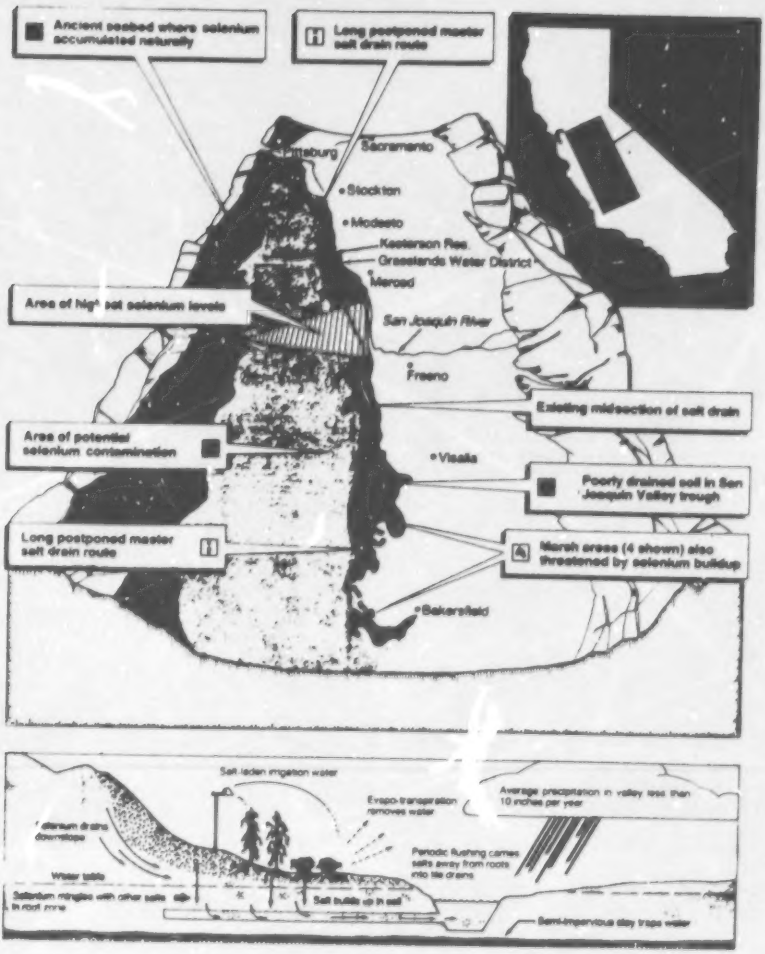

Ancient seabed where selenium accumulated naturally
Long postponed master salt drain route
Sacramento
Stockton
Modesto
Kesterson Res.
Grassiands Water District
Merced
Area of high salt selenium levels
San Joaquin River
Fresno
Existing midsection of salt drain
Area of potential selenium contamination
Visalia
Poorly drained soil in San Joaquin Valley trough
Long postponed master salt drain route
Marsh areas (4 shown) also threatened by selenium buildup
Bakersfield
Salt laden irrigation water
Evapo-transpiration removes water
Average precipitation in valley less than 10 inches per year
Periodic flushing carries salts away from roots into tile drains
Water table
Salt builds up in soil
Semi-impervious clay traps water

Figure 6. From: *The Sacramento Bee*, 24 March 1985.

mined. Millions of acres of farmland in California and nine other Western states may be threatened by toxic levels of selenium.[42]

Irrigation's Future

Earlier in this chapter, it was noted that there has been a reduction in the funding for new federal water projects, including irrigation projects. It is also questionable whether the federal government will spend the money

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necessary to clean up contaminated runoff water. Secretary of Agriculture John Block has indicated that heavily irrigated agriculture may be declining because of economic factors. It will be too costly to pump water from deep wells and there will be a trend away from low-priced water to subsidize agriculture.[43] Irrigation also consumes large amounts of energy.

> Although irrigation has brought considerable land under cultivation, it also has significant drawbacks: irrigation is energy intensive and it tends to be overused. Nebraska studies show that 43 percent of the energy used by agriculture goes to irrigation. In Wisconsin, fully half of the total direct energy requirements of potato production are expended in pumpage.[44]

Good crop management would reduce some of the harmful effects of irrigation. Agricultural economists Ronald Griffin and Daniel Bromley offer a few examples:

> Incremental fertilizer applications limit the amount of nitrogen placed in the ground at any one time and, once plants have established root systems, nitrogen can be more easily taken up by the plants at critical times during the growing cycle. Rotating crops—alternating between nitrogen-consumptive crops (e.g., potatoes and corn) and nitrogen-fixing crops (e.g., legumes)—keeps nitrogen in the soil root zone. Crop rotation also would help in the aldicarb issue because aldicarb is not certified for use on all crops.[45]

Computers have also been used to insure proper watering of plants. Similar computer applications could extend to use of chemicals and pesticides. As a last resort, if irrigated water cannot be used, farmers will shift to other crops requiring less water or they will go out of business.

Indian Water Rights

A final case study that will illustrate the complexities of water allocation policies involves access to Indian water rights. *Editorial Research Reports*, in an article on American Indian Development, sets the parameter of this discussion:

> American Indian tribes in arid Western states own potentially large shares of the region's scarce and economically valuable water. Tribal governments, recognizing the wealth that water could bring, have been pressing lawsuits and negotiating with federal and state officials to firmly establish Indians' rights to water flowing through their reservations. But those claims, staked out by a 1980 U.S. Supreme Court decision, are putting tribes into conflict with Western farmers, industries, cities and towns that in some areas already use all the water supplies available.[46]

In general, Indian water claims predate non-Indian water claims. The potential for conflict over scarce water has been realized in many instances. Rob Stern, Council of State Governments, notes:

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> Major conflicts exist in over 60 water basins involving more than 100 Indian communities throughout the West. The outcomes will affect urban growth in Tucson, Salt Lake City, Albuquerque, and Reno; energy developments in the San Juan, Power River and other resource basins; agriculture in Arizona, California, Nevada and Washington; and small ranchers and farmers all over the West. Whatever the decisions, they will have a major impact on Indian community economies.
>
> Major litigation is underway in at least 53 water disputes. Jurisdiction between states, tribes and the federal government is unclear. Management, water quality, proprietary rights and entitlement are all at issue.[47]

Legislation has not proven any more productive than litigation. Stern continues:

> In some cases the water code has been insufficient to address the breadth of the question, leading to further litigation. In others, political settlement depended on all parties' interest in developing further water supplies and the federal government's willingness to finance them. This, however, is hardly a general solution in an age of "new federalism" and water project cost-sharing. . . .
>
> Congress in 1983 passed a bill incorporating the results of negotiations between Papago Indians and private and municipal parties over water rights in south Arizona. President Reagan vetoed the bill which depended too heavily on federal spending, approving a revised version only with greater state/local cost-sharing provisions (PL 97-2939).[48]

The Department of the Interior announced in 1982 a decision to negotiate all pending Indian water claims, but the process has proven to be extremely slow and time consuming.

Most tribes lack the capital to build water distribution and irrigation projects. For example, along the Colorado River, about 60 percent of the irrigable acreages is on Indian lands, but only 8 percent was being cultivated by Indians.[49] Some reservations have traded water rights for other economic benefits. Robert Coats, a scientist at the Center for Natural Resource Studies, explains:

> Since the reservations are lacking in capital to develop either sufficient agriculture or industry, some Indians have been willing to bargain away water rights in exchange for development.
>
> For example, in exchange for the Navajo Indian Irrigation Project, the tribe agreed to waive its priority on the San Juan River. In exchange for a coal-fired power plant, the tribe agreed to limit its demands on the Little Colorado to 50,000 acre-feet per year. These arrangements, which are seriously questioned by some Navajos, suggest that, in a free market for water rights, the Indians might be separated from rights to water they are not currently using.[50]

Unsolved Indian water claims will play an increasing role in the development of the western states. Any proposed allocation system must

consider the importance that water resources have assumed in Indian development efforts.

Fresh Water Supply

After completing an examination of some of the problems and potential issues involved with water policy in the United States, the options for dealing with water scarcity should be briefly explored. The first approach would seek to increase the supply of freshwater. This has been the response most frequently used in the *status quo*. John Shaeffer notes:

> For decades, the linear system appeared to be working. A reliable and safe water supply was provided inexpensively. When development occurred in a water-poor area, freshwater was piped from a seemingly unlimited source in another county or state. Lavish use of water was promoted and, as a result, freshwater use increased dramatically between 1955 and 1975—160 percent—to a per capita consumption of some 150 gallons per day.[51]

Attempts to augment the supplies of water in this manner will be difficult. The Trend Analysis Program argues: "Development of new, fresh supplies is much harder than in the past; the best reservoir sites and the most regularly flowing rivers have already been utilized."[52] Plans have been mentioned that would create a large canal to use the waters in the Great Lakes, which contain 95 percent of the surface freshwater in the United States. This canal proposal is taken seriously enough for the governors of eight states and the premiers of two Canadian provinces to sign a Great Lakes Charter, which, they hope, will deter diversion of later water.[53] Another idea is to "capture icebergs in the polar regions and tow them south to areas like Los Angeles, where they could be melted down for fresh water."[54]

A more likely proposal is "to make previously unusable water usable through elimination of pollution, recycling of wastewater, and desalination. Projects to accomplish these purposes, however, are expensive and take years to complete."[55] Desalination projects have operated along the Colorado River for over ten years, and a recently enacted Water Research bill provides support for several pilot projects to remove salt from water. Recycling has also been tried in the United States in pilot programs such as the 1974 wastewater project in Muskegon County, Michigan. Denver is currently "conducting a water reuse project using complex technology to convert some sewage effluent into potable water. The city hopes to increase drinking water supplies by 15 percent by the end of this century to meet the demand."[56] John Schaeffer notes that Europoean farms have used "nature's purification system to reclaim both the water and the wastes (resources) it carried from some of the world's largest

cities—Paris and Berlin, for example."[57] He explains this as a circular approach to water use.

> The circular approach, which uses wastes as raw materials, must replace the linear approach, which seeks to get rid of wastes by discharge into some receiving body of water. In the circular approach, capital expenditures are directed to the development of facilities that will use wastes as raw materials to generate food, fiber, and energy resources. This system automatically leads to regional reuse, which mitigates water supply shortages. In addition, when the same circular philosophy is applied to stormwater runoff or flooding problems, these surplus waters are managed so that they are available for future use, thereby becoming a part of the available water resource.[58]

Water Conservation

Tremendous amounts of water are wasted every day. Water conservation is the key to insuring adequate resources for future generations. The essence of conservation is reduced waste use or loss. One prominent environmentalist has claimed that "the water conservation potential for our nation is so great that there is no need to build more water supply reservoirs for the rest of this century."[59] Duane Baumann, a geographer at Southern Illinois University, reviewed government statutes and the literature from professional associations and concluded:

> Water conservation has been accepted by major sectors of the water supply community as an essential element of water resource planning and management. Public response to various programs and initiatives suggests that most citizens also view water conservation as a reasonable and necessary step. In one survey of 1383 households in both humid and semiarid regions, 86% perceived the need to conserve as moderately important or very important.[60]

The Trend Analysis Program also found conservation the most important option for reducing future water shortages.

> Conservation is probably the most effective avenue to alleviating existing and future water shortages. Potential for savings exists in agriculture, municipal, and industrial use of ground and surface water. The greatest opportunities are in water for irrigation, since it comprises such a major component of use. There are also considerable opportunities for conservation in nonagricultural uses. Industry has been a leader in the recovery and reuse of water, and conservation is now growing at the municipal level.[61]

The government could develop conservation regulations that would force, by law and enforcement efforts, a reduction in water use or a free-market approach could be developed. Government regulation is a common model for problem solving and its advantages and disadvantages

are well-documented. Debaters may be less familiar with the market mechanism approach. Most free-market proposals involve increasing the price of water:

> An analogy is often made with the unexpected extent of energy conservation caused by the leap in oil prices. A recent General Accounting Office report on water issues concludes that "water is too valuable to be given away or priced way below cost in today's or tomorrow's environment." Suggestions include creation of a "water market" that would allow farmers to sell water they do not need to the highest bidder as an incentive to eliminate waste, or the pricing of water closer to its cost through hikes in tax rates and water and sewer bills.[62]

Water is now priced below its real market value. This is especially true of agricultural water. Farmers pay only a fraction of the cost from federal and state irrigation projects. The result is wasteful usage. An editorial in *The Sacramento Bee* argues:

> The underpriced water sends a false signal to landowners, who plant crops and use farming methods inappropriate to the real cost of irrigating their fields. And it sends a false signal to policy-makers, who get the idea that it's not economically necessary to look for better ways to provide water than by expanding the State Water Project.
>
> It's largely because state project water comes so cheap to rural customers—and federal irrigation water is even cheaper—that there is so little interest among them in establishing sensible, money-saving regional programs for conjunctive management of groundwater and other water resources.[63]

A higher price would be a powerful incentive to conserve water and, if the cost is high enough, to stimulate research and testing of alternative methods for securing freshwater such as desalination. Higher prices would also encourage technological development of new products. For example, flushless toilets could save about half the water now used in households and new strains of wheat, corn, and other crops could be developed that require less water.[64]

Conclusion

This chapter considered those issues involved in the discussion of water scarcity and allocation systems. No crisis develops without warning signs, and policymakers have ample opportunity to address themselves to problems caused by inefficient use of water resources. Contamination of the water supply, overuse of water for irrigation, and ongoing development efforts are factors that must be thoroughly researched and discussed.

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